STRAPPING IN AND BAILING OUT:

NAVY AND AIR FORCE JOINT ACQUISITION OF AIRCRAFT

BY

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A THESIS PRESENTED TO THE FACULTY OF

THE SCHOOL OF ADVANCED AIRPOWER STUDIES

FOR COMPLETION OF GRADUATE REQUIREMENTS

SCHOOL OF ADVANCED AIRPOWER STUDIES

AIR UNIVERSITY

MAXWELL AIR FORCE BASE, ALABAMA

JUNE 2002

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
00 JUN 2002	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Strapping In And Bailing Out: Navy And Air Force Joint Acquisition Of Aircraft	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air University Maxwell Air Force Base, Alabama**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**104**	

DISCLAIMER

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.

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ACKNOWLEDGMENTS

I would like to acknowledge several individuals for their concerted effort in the completion of this project. I want to thank "His Royal Chiefship" Bob Laymon of Raytheon Aircraft Corporation for granting me several interviews and for his insight into the acquisition world. I would also like to acknowledge the tireless efforts of Paul "Wiedie" Wiedenhaefer of the Joint Strike Fighter Program Office. These two gentlemen provided knowledge and guidance through the maze of current and past acquisition programs.

I would also like to recognize Colonel Chiabotti and Major Terino for the lengthy discussions and tireless efforts in reviewing and editing my futile attempts. Colonel Chiabotti deserves special credit for kicking me back into play after straying off the subject several times.

Finally, I would like to thank my wife, Erica, and my son, Alex. Without their love and support this project would have infinitely more difficult.

ABSTRACT

This study analyzes past Air Force and Navy trainer and fighter aircraft programs and determines when conditions may be favorable for joint acquisition opportunities. Five case studies are examined with respect to cost, schedule, and performance characteristics and the interactions of the Air Force and the Navy. Specifically, the details of the Tactical Fighter, Experimental (TFX), the Next Generation Trainer (NGT) T-46A, the T-45A Goshawk, the Joint Primary Aircrew Training System (JPATS), and the Joint Strike Fighter (JSF) are reviewed and compared.

The study indicates that for joint acquisition to be a profitable venture, two conditions must be met: a common mission and a definite need, absent suitable alternatives. The type of mission matters less than commonality of performance requirements, while need generally brings money to the table.

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Introduction

The Department of Defense oversees the acquisition of equipment for all the services. Because the amount of funding available for new systems is finite, difficult decisions must be made every budgeting cycle. The services can collude on a project and theoretically save the government significant amounts of money. By jointly acquiring weapon systems, the services mutually agree that all involved possess both the need for the equipment a reasonable probability of arriving at common performance requirements.

But the history of joint acquisition would suggest otherwise. The Air Force and the Navy, in particular, have not been able to jointly acquire an aircraft that satisfied both services. What drives the perceived inability of the services to work together in this process? Several factors come to mind: parochial interests, "top-down" demands for commonality, disparate missions and operating environments, differing priorities attached to flying aircraft, etc. Any of these factors alone could kill a program, and a combination is sure to be deadly.

In an attempt to identify where the problem may lie, this thesis poses the question: can joint acquisition and joint procurement of aircraft be achieved without endangering requirements specialized for separate services? To help answer the question, five case studies will be examined using an analytical framework composed of three factors: cost, schedule, and performance. These were selected because they directly relate to the service needs and resources available to fund those needs. These three factors are key in determining if a program will be acceptable to all concerned parties. The case studies to be examined are: Tactical Fighter, Experimental (TFX), the Next Generation Trainer

(NGT) T-46A, the T-45 Goshawk Navy advanced trainer, the Joint Primary Aircrew Training System (JPATS), and the Joint Strike Fighter (JSF).

Before delving into the case studies, the thesis will provide a brief history of joint acquisition. As will be demonstrated, the services have had a difficult time working together to solve the problems of joint acquisition.

Chapter 1

History of Acquisition

The more I studied past history, the murkier and more obscure became the background…it seemed such a dangerous thing to write about that I gave it up.
Hugh Clausen, 1920

This chapter will describe the acquisition process as it developed during the early years of the United States and as it matured into the system we have today. As early as the Civil War, the problems of getting the best equipment at an affordable cost to the warfighters were numerous. Many factors would emerge to impact the decision-making process of the military: parochialism, personal bias, the birth of a new service (Air Force), and technology. These issues would demand the attention of the service chiefs and the interest of the United States Congress. As the budget became smaller to pay for more expensive weapons systems, the process for acquisition desperately needed reform. The passage of the Goldwater-Nichols Defense Reorganization Act of 1986 provided the impetus for the services to work together and efficiently utilize the resources appropriated to them via the defense budget.

Pre-World War II

Before the Civil War, the Union Army was aware of several new types of repeating arms. These weapons held promise to be more efficient and better than the current stock of muzzle-loading weapons. However, due to personal bias and parochialism, the Secretary of War, Joel R. Poinsett and the Ordnance Department

decreed that no new weapons would be allowed into the inventory unless they were "convinced of their superiority by long tried experiments in the field."[1] Through the years of the Civil War attempts were made to put the repeating arms into the hands of the soldiers for field tests; the soldiers loved the new weapons, and they were the favorite of the Army. Finally, the new Secretary of War, E.M. Stanton, decreed that the new weapons would be standard issue for the service. This decision came in December 1865.[2] Fifty years after the Union's debacle with repeating rifles, the United States Army Signal Corps experienced a similar dilemma. In 1914, the war in Europe was on the horizon and Congress responded by establishing the Aviation Section of the Signal Corps. Their act created a sanctioned section, making permanent the employment of men and machines that also provided for special aviation ratings and flight pay. By making the section permanent, Congress permitted manufacturers to run the risk of building aircraft for military purposes. However, there were those within the service who weren't convinced of the efficacy of the air weapon. As with the breech-loading repeaters of fifty years prior, actual demonstration of the viability of a weapon was required before it would be accepted into the fold.[3]

A small group of men stationed at North Island in San Diego Bay were responsible for setting the first requirements for an observation aircraft: a two-place

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[1] I. B. Holley, Jr., *Ideas and Weapons* (1953; new imprint, Washington, D.C.: Office of Air Force History, 1983), 6.

[2] Ibid, 9.

[3] Ibid, 34.

biplane capable of lifting a useful load of 450 pounds at a high speed of 70 mph.[4] While important for defining the aircraft as a useful military aircraft, the delineation of requirements and specifications also established a new procedure for selecting the weapon: competition between rival manufacturers. Objective tests of speed and rate of climb, subjective tests of field of vision, as well as evaluation of construction and standards of workmanship were combined to assess the tactical suitability of submitted designs. By the end of 1916, the Signal Corps had established both a method for selecting superior weapons and a close working relationship with the manufacturers supplying them.[5] But the air weapon still was not considered important for budgetary considerations. The coming war in Europe would change that mindset in the United States.

Congressional action in June 1916, authorizing increases in personnel and materiel, marked a turning point. The importance of the airplane, demonstrated in the European war and rapidly gaining recognition in the United States, resulted in the National Defense Act. Eighteen months after the outbreak of war, the Chief Signal Officer (CSO) was ready to admit that the air weapon had proved its legitimacy. The CSO differentiated three types of aircraft he considered necessary: a reconnaissance and artillery fire-control type, a combat type, and a pursuit type. With this new recognition of the role of aviation, the Chief proposed to establish squadrons of each of these aircraft. By using the conclusions gained from experience in Europe, and by delineating

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[4] Ibid, 34.

[5] Ibid, 34.

requirements for aircraft types and numbers, the Signal Corps set the standard early for acquisition and procurement of air weapons.[6]

The System is Broken

After the end of the "War to End All Wars," America withdrew into isolation. During the interwar years, the United States downsized and reduced the military to levels commensurate with its foreign policy. Defense was the only posture legitimized and contemplated. Entering the Second World War, the US had an archaic military organization. It was incapable of coordinating land, sea, and air activities across the two military departments, or even of harmonizing business activities (acquisition) within the departments themselves.[7] During WWII, the Joint Chiefs of Staff stood up as advisors to the President. However, since all the JCS were required to agree on the advice, what essentially got to the President was watered down to the lowest common denominator.[8] As the services grew during the war, the organizational challenges were many, and the Army Air Forces would emerge as a dominant branch. The dropping of the bombs on Hiroshima and Nagasaki cemented the Air Force's position as both THE agent for nuclear delivery and a force to be reckoned with in future budget battles. As the war drew to a close, General of the Army Henry "Hap" Arnold tasked a group of scientists to look into the future and set the basis for a long-term research and

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[6] Ibid, 35.

[7] James R. Locher III, "Has It Worked? The Goldwater-Nichols Reorganization Act." *Naval War College Review* 44, No. 4 (Autumn 2001), 96.

[8] Ibid, 97.

development program.[9] The final report, *Toward New Horizons,* presented an excellent roadmap and treatise on how science and technology could assist the Air Force mission. This report may also embody grounds for accusing the Air Force of worshipping at the altar of technology. The discussions within the report indicated little interest in dealing with joint operations, and seemed to focus on ensuring that the Air Force became a separate entity within the Department of War.

At the end of World War II, service parochialism soared as the Air Force desired independence and the other services saw this as a bid for power. President Truman had suggested an independent Air Force, coequal with the Army and the Navy, unified under a single department of National Defense.[10] The Army liked the idea of an independent Air Force, but the Navy resisted, saying it liked the status quo. The Army Air Forces were prepared to go to "battle" with the Navy for independence.[11] The Navy's biggest fear was that the Army Air Force would take over naval aviation and the Army would grab the Marine Corps.[12] The Navy also felt that it could not compete with

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[9] Dr. Theodore Von Karman, *Toward New Horizons: A Report to General of the Army H. H. Arnold.* Air University Library Document M-30485NC, 15 December 1945, iii. Document is now declassified. Unwittingly, General Arnold may have given birth to the Air Force problems with parochialism. Dr. Karman's opening has many details pertaining to how only the Air Force can deal with particular military issues.

[10] Herman S. Wolk, *Planning and Organizing the Postwar Air Force 1943-1947* (Washington, D.C.: Office of Air Force History, United States Air Force, 1984), 153.

[11] Ibid, 153.

[12] Ibid, 153.

both the "powerful" atomic AAF and the large standing Army.[13] The Navy continued to demand its traditional roles and missions be left unfettered and stayed distrustful of a single department (National Defense) and a single civilian secretary. The Army countered that "such self-sufficiency fostered tremendous duplication at prohibitive costs."[14] It was the War Department's view that the services should not be self-sufficient; they should be self-supporting.[15] President Truman emphasized that the services should be coordinated, coequal, and run by individual service secretaries. He also emphasized the "internal administration of the three services should be preserved in order that the high morale and esprit de corps of each service be retained."[16] The Department of the Navy and the Congress of the United States shared similar suspicions. The Navy was still in disagreement over the new arrangement of services because the Navy was unsure of the other services' motives.[17] The Congress was also leery of unification under a single cabinet-level secretary; the executive branch may have organized so effectively as to put Congress at a disadvantage. Congress felt that they could be more effective in a military establishment where authority was diffused.[18]

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[13] Locher, 98.

[14] Wolk, 154.

[15] Wolk, 153.

[16] President Harry S Truman to Secretary of War Robert P. Patterson and Secretary of the Navy James V. Forrestal, Letter, June 15, 1946, RG 341, P&O, PD 020 (Nov 2, 1943), Section 2/448, in Wolk, pg. 155.

[17] Wolk, 155.

[18] Locher, 98.

The National Security Act of 1947 created the National Military Establishment, the Secretary of Defense, and the Air Force as a separate service. In 1958, then President Eisenhower reflected on the negotiations that took place: "In that battle the lessons were lost, tradition won. The entire structure is little more than a weak confederation of sovereign military units."[19] This "weak confederation" was the foundation for our military leadership up until 1986. As the years went along, several failures pointed to specific problems within the Department of Defense (DOD). These failures included: the Vietnam War, USS *Pueblo*, the *Mayaguez* incident, the Marine barracks bombing in Beirut, Grenada, and Desert One. All of these operations indicated poor military advice to political leaders, lack of unity of command, and an inability to operate jointly.[20] Also, some think DOD suffered from an inability to formulate a security strategy within fiscal constraints, as well as an inability to allocate resources to support the strategy. Not only were the services weak at working together in combat and combat planning, but it appeared they could not even agree on interoperability in their weaponry.[21] Even the big system to procure systems was broken.

Joint Acquisition Prior to 1986

Prior to 1986, the designation "joint" was generally left to the discretion of the Office of the Secretary of Defense (OSD). During this timeframe, Congress sensed

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[19] Quoted in Alice C. Cole et al., eds., *The Department of Defense: Documents on Establishment and Organization, 1944-1978* (Washington, D.C.: Office of the Secretary of Defense, 1978), p. 177, in Locher, p. 99

[20] Locher, 99.

[21] Ibid, 100-101

that there was a duplication of effort between the services, and attempted to write language into the law to compel OSD to make the services coordinate their efforts.[22] OSD attempted to comply. Some joint programs appeared: Low cost fighter (YF-16/17) (Air Force/Navy), and Joint Tactical Missile System (JTACM) (AF/Army) are examples. They quickly became service-specific - *joint in name only* - programs due to the lack of support from both services. There was no incentive for individual services to work together toward a common solution. In fact, there was a strong impetus not to cooperate. If you were able to blend your requirement with a sister service, what would keep that service from taking that mission in the "roles and missions" debate?[23] Joint programs, as designated pre-1986, often received less than stellar support from the separate services. Within a service, competition for program dollars was fierce, and any adjustment made in one program would result in adjustments in another.

Some weapons systems were acquired and used by more than one service. These included: F-4 and A-7 aircraft, the Sidewinder missile and the M1 tank.[24] However, the historical record of success for joint programs prior to 1986 is mixed. Service secretaries dedicated themselves to "working the system" to ensure service uniqueness remained.

During the "hollow force" years preceding 1986, a special commission was established to investigate defense management. Better known as the "Packard

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[22] James R. McKenzie, Captain, USN, "Who is Responsible for the Joint Acquisition Mess?", (Executive Research Project S53, The Industrial College of the Armed Forces, 1993), 15.

[23] Ibid, 15.

[24] Ibid, 16.

Commission," the President's Blue Ribbon Commission on Defense Management was a high-powered organization granted full investigative powers throughout the Department of Defense. The Commission included Mr. Frank Carlucci and Dr. William J. Perry, future Secretaries of Defense, as well as a retired flag officer from each of the four services.[25] In July 1985 the Commission was charged to conduct a study encompassing current defense management and organization in its entirety, from the budget process for each of the services all the way up to DOD interactions with Congress.[26] The Commission attempted to determine the root cause of defense problems; the changes submitted were driven by the enduring propositions of sound national security policy, effective government, and basic management. These principles guided the Commission's recommendations, and they applied to both warfighting and managing a weapons program.[27]

The Commission set the following propositions:

Overall defense decision-making by the Executive Branch and the Congress can be improved.

Our military leadership can be organized and chartered to provide the necessary assistance for effective long-range planning.

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[25] David Packard, *An Interim Report to the President,* The President's Blue Ribbon Commission on Defense Management, (Washington, D.C., 28 February 1986), cover letter.

[26] Ibid, 1.

[27] Ibid, 2.

Control and supervision of the entire acquisition - including research, development, and procurement - can be strengthened and streamlined.

Waste and delay in the development of new weapons can be minimized, and there can be greater assurance that military equipment performs as expected.

The Defense Department and defense industry can have a more honest, productive partnership working in the national interest.[28]

The Packard Commission was the driving force behind the Goldwater-Nichols Defense Reorganization Act of 1986 (GNA). On 1 October 1986, GNA became law. Congress correctly recognized the value of separately organized military departments that competed to best meet the requirements of the Commanders-in-Chief (CINCs) by offering alternative program recommendations. Congress also perceived the need for more direction of the U.S. armed forces. The provisions in the act reflect these countervailing concerns.[29] In passing GNA, Congress intended to: reorganize the DOD; strengthen civilian authority; improve military advice to the President, the National Security Council (NSC), and the Secretary of Defense; place clear responsibilities and

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[28] Ibid, 2.

[29] Douglas C. Lovelace, Jr., *Unification of the United States Armed Forces: Implementing the 1986 Department of Defense Reorganization Act*, (Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 1996), 14.

authority on unified and specified combatant commands for the accomplishment of missions assigned; increase attention to the formulation of strategy; provide for the more efficient use of defense resources; improve joint officer management policies; and enhance the effectiveness of military operations.[30] With respect to joint acquisition and joint procurement, GNA forced the services to work together to solve the problem of limited funding and weapons modernization. GNA also strengthened the position of the Chairman of the Joint Chiefs of Staff, providing the Chief with the tools and authority required to direct the services in their acquisition goals and objectives.

Department of Defense Acquisition Requirements

The Secretary of Defense and the Chairman of the Joint Chiefs of Staff guide the acquisition process. DOD Directive 5000.1, *The Defense Acquisition System,* is the overarching directive, providing the policies and principles for all DOD acquisition programs. "The primary objective of Defense acquisition is to acquire quality products that satisfy user needs with measurable improvements to mission accomplishment and operational support, in a timely manner, and at a fair and reasonable price."[31] This objective is met by focusing on five major categories: achieving interoperability, rapid and effective transition from science and technology to products, rapid and effective transition from acquisition to deployment to fielding, integrated and effective operational

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[30] Ibid, 15.

[31] Department of Defense Directive (DODD) 5000.1, *The Defense Acquisition System,* 23 October 2000, 15.

support, and effective management.[32] DOD Instruction (DODI) 5000.2, *Operation of the Defense Acquisition System,* supplements DODD 5000.1 by providing a simplified and flexible management framework for translating mission needs into stable, affordable, and well-managed programs.[33] The Instruction also recognizes that every technology product is unique and may not necessarily follow the entire acquisition process. DODI 5000.2 focuses on two key areas that are important for successful acquisition and smooth integration: an integrated management framework and key capability enablers. The integrated management framework is the DOD's principal decision support system and comprises of the following components: the Requirements Generation System (RGS), the Defense Acquisition System (DAS), and the Planning, Programming, and Budgeting System (PPBS). Key capability enablers are information superiority and interoperability. DODI 5000.2 defines interoperability as "the ability of systems, units, or forces to provide data, information, materiel, and services to and accept the same from other systems, units, or forces and to use the data, information, materiel, and services so exchanged to enable them to operate effectively together."[34] Interoperability is a cornerstone for all joint acquisition programs, and allows the services to operate seamlessly on the battlefield.

Weapons requirements for the warfighters are generated by the procedures outlined in CJCSI 3170.01B *Requirements Generation System.* Essentially, this

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[32] Ibid, 2-7.

[33] Department of Defense Instruction (DODI) 5000.2, *Operation of the Defense Acquisition System,* 23 October 2000, 1.

[34] Ibid, 6-7.

instruction provides policies and procedures for developing and approving Mission Need Statements (MNSs) and Operational Requirement Documents (ORDs). CJCSI 3170.01B also delegates oversight authority for the requirements generation system to the Vice Chairman of the Joint Chiefs of Staff, assisted by the Joint Requirements Oversight Council (JROC) and members of the Joint Staff.[35] The JROC facilitates the execution of CINC operational requirements, while the CJCS assesses military requirements for defense acquisition programs. Each service is responsible for organizing, supplying, equipping, training, and related functions in order to meet the current and future operational requirements of the unified commands. The services are also charged with eliminating duplicative effort through cooperation and coordination with the other Services and DOD agencies.[36] CJCSI 5123.01A *Charter of the Joint Requirements Oversight Council* defines the JCS role in advising the Secretary of Defense on requirements programs and budgets.[37] The JROC identifies and assesses a priority of systems to meet the national military strategy, considers alternatives, if necessary, and ensures the selected priorities conform to the expected funding in accordance with the Defense Planning Guidance (DPG). The services, including Guard and Reserves, have a place, under the chairman, on the JROC.[38] Empowered by GNA in 1986, the JROC

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[35] Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01B, *Requirements Generation System,* 15 April 2001, 1.

[36] *Armed Forces, U.S. Code,* Title 10, sections 3013, 5013, and 8013, (2001).

[37] Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 5123.01A, *Charter of the Joint Requirements Oversight Council,* 8 March 2001, 1.

[38] Ibid, A-1-A-3.

provides guidance to the CJCS so that he can fulfill his statutory responsibility of advising the Secretary of Defense on requirements, programs, and budgets. The CJCS also provides an assessment of to the Secretary of Defense via the Chairman's Program Assessment (CPA). The CPA describes how each service is conforming to its Program Objective Memorandums (POMs) as compared to the priorities established in the CINCs' strategic plans.[39]

Conclusion

GNA provided the DOD with a roadmap for doing business. Have all the problems of service parochialism, lack of interoperability, mistrust of other services, and stewardship of funds disappeared in the post-GNA era? We have come a long way, but there is still work to be done, as noted by Chairman of the Joint Chiefs of Staff, General Richard B. Myers, "The capabilities of the joint force form the foundation of operational agility and thus are key to victory in this war (war on terrorism) and in future conflicts…. Though jointness has improved markedly since the Goldwater-Nichols Act of 1986, there is still much to do…. The Joint Force must have systems that are born joint."[40]

The CJCS provides a solid reflection of the needs of the services and where DOD needs to go to be an effective fighting force of the future. The services are required to provide the CINC with forces and capabilities, which the CINC then uses to facilitate the National Military Strategy (NMS) and National Security Strategy (NSS).

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[39] Ibid, A-1.

[40] Gen Richard B. Myers, "A Word from the Chairman," *Joint Force Quarterly*, Autumn/Winter 2001/2002, 4.

Because the services are in competition for portions of the defense budget, the concepts of joint acquisition and joint procurement are noble ideals. However, will service capabilities be diminished through the joint acquisition process? Can joint acquisition and joint procurement be achieved without endangering performance requirements specialized for separate services?

The following chapters will provide case studies of past and current acquisition programs. Two fighter and two trainer programs were selected; these programs expose the problems of dealing with dichotomous requirements of the Air Force and the Navy. The first case study will look at the Tactical Fighter, Experimental (TFX) program and the difficulties experienced in the early years of the quest for commonality. The next case study will look at two trainer programs, the Air Force's Next Generation Trainer (NGT) T-46 and the Navy's T-45 Goshawk. Although not jointly acquired, both systems were evaluated for use in the other service. The third case study will examine the Joint Primary Aircrew Training System (JPATS). This program aligns Air Force and Navy primary training aircraft resources and provides the services with a common trainer. The final case study is the Joint Strike Fighter (JSF) program. This program is designed to provide the services with a family of aircraft to meet mission requirements as dictated by the separate services. To evaluate the programs, comparisons will be made in performance, scheduling, and costs. Performance is defined as service requirements demanded of the aircraft and the mission roles it is expected to fulfill. Scheduling refers to two separate concepts: the production of the system and when it will reach its initial operational capability (IOC); and the timeline used by the services to evaluate the need for the system against all available alternatives. Costs are evaluated in unit flyaway costs

and expected costs over the service life of the aircraft. The service life costs include the maintenance man-hours per flying hour (MMH/FH) costs as well as costs per flying hour (fuel, lubricants, and parts).

Analysis of these case studies should provide valuable insight and direction for the further reform of the joint acquisition process. Ultimately, this reform would then lead to the Holy Grail of procurement: better weapons systems for all services at affordable prices.

Chapter 2

Tactical Fighter, Experimental

We don't buy the best there is in terms of technology in any one of our weapons systems. We should buy only what we need.
Secretary of Defense Robert McNamara

But even the Pentagon admits it's not the plane it wanted, or set out to build. It's as if you started out to buy a Volkswagen, and ended up with a Cadillac.
Jules Bergman, ABC-TV, 30 March 67

The genesis of the Tactical Fighter, Experimental (TFX) program began with General F. F. Everest. He had a dream of a fighter that would perform in ways never before possible. As commander of Tactical Air Command (TAC) it was his job to 1) obtain and maintain air superiority over the battlefield (air-to-air combat) 2) to disrupt the enemy's forces by interdicting his supply caches and supply routes (interdiction) and 3) to provide close support for the Army's ground forces (close air support).[41] The best

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[41] Robert J. Art, *The TFX Decision: McNamara and the Military,* (Boston: Little, Brown and Company, 1968), 15-16. "…these three missions represented TAC's dogma, to which Everest had to pay lip service. It appears, however, that he was interested primarily in having his new aircraft penetrate enemy defenses at low level at supersonic speeds while carrying nuclear weapons." By trying to acquire a nuclear capability for TAC and by thus providing it with an ability to deliver nuclear weapons in a way that SAC's B-52 bombers could not (by low level, supersonic penetration), Everest attempted to protect the present identity of and future role for TAC.

that the Air Force had to offer at the time was the F-105, a very capable fighter, but one that did not meet the mission requirements of this "wonder aircraft." Additionally, Everest saw that the number of usable airfields overseas limited the Air Force's flexibility when tasked to provide support to the European theater. Thus the requirements were set for the TFX: takeoff from either a sod/unprepared airstrip half the length of that required by the F-105 (~3000 feet), travel non-stop, without aerial refueling, across the Atlantic Ocean, ingress at tree-top level to avoid early radar detection, deliver its payload, and egress to land at another unprepared field somewhere in Europe. He also insisted that it engage in aerial combat at high altitudes at speeds approaching 1,700 miles per hour. Finally, he stipulated that the aircraft have a large ordnance-carrying capacity.[42] Everest's desire for the new aircraft was also driven by the tactical air imbalance he had witnessed first-hand in Europe. He knew that Western Europe would be inundated with Soviet tank columns or showered with nuclear warheads.[43] As General Everest later recalled, "…I was interested in a fighter that would have good survivability and an excellent chance of performing a successful combat mission after its initial landing in Europe."[44]

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[42] Art, 18.

[43] *The TFX: Conceptual Phase to F-111B Termination (1958-1968) (S).* K243.04-50 (January 1958-January 1968, Office of History, Headquarters, Air Force Systems Command (AFSC), in the USAF collection, AFHRA, document is now declassified), 2-3. Hereafter referred to as AFSC History.

[44] AFSC History, 3.

Variable Geometry and The United States Navy

To satisfy the varying flight conditions demanded by General Everest required a swing-wing design. The requirements called for an aircraft that could go extremely fast, ferry for long distances, land and take off from short/unprepared fields, and carry lots of weapons. To go fast the aircraft would need a narrow frontal area and a highly swept wing. To go extremely long distances un-refueled, the aircraft would need a highly efficient wing and travel at moderate speeds for fuel consumption considerations. To take off and land from short/unprepared fields, the aircraft would need powerful engines and a nearly straight wing with lift-enhancing devices (flaps, slats, etc). General Everest had a friend in the aeronautical business, Dr. John Stack. Dr. Stack pursued many interests, including variable geometry (VG) wing structures, and this variable geometry was exactly what General Everest needed for his new aircraft.[45] Air Force

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[45] AFSC History, 3. Mr. John Stack was active in aerodynamics circles since his graduation from MIT in 1928. He began his career as a research engineer at the National Advisory Committee for Aeronautics (NACA) and rose through the ranks as Section Head, Division Chief, Assistant Director, and finally Director of Aeronautical Research for the National Aeronautics and Space Administration (NASA). He twice received the Collier Trophy—once (1948) with Capt Charles E. Yeager, USAF for pioneering supersonic manned flight; again (in 1952) for transonic wind tunnel development. Stack made many aeronautical contributions, including primary responsibility for the design and construction of the country's first large high speed wind tunnel, follow-on tunnels, X-1 through X-5 aircraft experiments (through which he pursued Variable Geometry (VG) and the X-15 program. He served on the DOD

Systems Command (AFSC) conducted a feasibility study, and found that idea was solid. NASA research also indicated that a swing-wing aircraft would be technically sound.[46]

At the same time, the Navy had designs for a new aircraft for fleet air defense. Fleet air defense required the aircraft to circle the fleet at high altitudes for long periods of time and use missiles. This demanded a long-endurance aircraft with a complex missile system. Although the Navy wanted the aircraft to perform other missions, fleet air defense would be its primary role. The Navy focused on designing the aircraft around the radar antenna.[47] The Navy was aware of the VG work of Dr. Stack, but stuck to its guns on the uniqueness of carrier-based fighters.[48] The F-6D Missileer was the Navy's answer to its fleet air defense problems.

A New Administration

The acquisition environment was about to undergo a drastic change of climate. The outgoing Eisenhower administration did not want to commit the Kennedy administration to any new major weapons systems programs. The TFX (multi-mission, single service, USAF) and F-6D Missileer (single-mission, single service, USN) acquisition programs were stopped awaiting the new administration's marching orders.[49]

Scientific Advisory Committee, on the three-man steering group, and in May 1962 left government service to join Republic Aviation Corporation as Vice President.

[46] Art, 22.

[47] Ibid, 26.

[48] AFSC History, 3.

[49] Art, 27.

Secretary of Defense McNamara brought to the office a new way of doing business. President Kennedy required a change of policy from the current massive retaliation doctrine, and McNamara provided a flexible response strategy. The combination of McNamara's past business background and the flexible response strategy led to the development of cost-effective ways of buying weapons systems.[50]

From the beginning, McNamara embraced the TFX program. It embodied everything that he was looking for: a cost-effective method (one aircraft to perform multiple missions) to provide both services with a weapons system to perform their missions.[51] This would minimize the costs of procuring a new tactical fighter aircraft. This evaluation led Secretary McNamara to pursue the multi-mission aircraft along a multi-service acquisition path.[52]

Stalemate

The Air Force and the Navy immediately distrusted the other service for fear of losing missions and losing control of the acquisition of the TFX. The Air Force was concerned about the penalties and compromises the service would have to make to accommodate carrier compatibility. The Navy was concerned about the TFX's ability to operate from a carrier environment and feared the needs of its service would get lost in a

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[50] Art, 30. McNamara was a professor at the Harvard Business School before WWII, a lieutenant colonel in the Army Air Forces during that war, and president of the Ford Motor Company in 1960.

[51] AFSC History, 13.

[52] Art, 32-33.

program managed by the Air Force.[53] The F-6D Missileer had been cancelled, and thus the Navy TFX requirements were driven by carrier operations and the mission of fleet air defense, with its significant radar dish and loiter requirements. For carrier operations, the most important design considerations are the aircraft's ability to get airborne and to land. The catapult and arresting gear must be able to propel or restrain the aircraft, limiting the weight of the aircraft. The character of the landing gear was the true issue; as the strength of the gear increased, so did the weight of the aircraft. Another consideration for launch and recovery is the over-the-deck wind speeds. At the time, the carrier technology limited that speed to approximately 30 knots, providing another limitation to the TFX for carrier compatibility. To fit on the carrier, the aircraft would have to be hangared below decks, which limited the height. To move from the hangar deck to the flight deck, the aircraft would have to be moved by an elevator, limiting its weight and length.[54] To summarize the differences, the Navy needed a relatively "fat" aircraft to loiter and employ missiles, and the Air Force needed a "sleek" aircraft to perform its desired tasks. Each service was committed to its original design and requirements and would not budge. "The technical disagreements really represented a struggle by the Air Force and the Navy to keep their (service) identities separate, distinct, and autonomous."[55]

Memorandum of September 1

McNamara became increasingly irritated by the services' inability to work together. To solve the problem, Secretary McNamara issued the Memorandum of

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[53] Ibid, 42.

[54] Ibid, 42.

[55] Ibid, 44.

September 1, which stated that if the services were not going to work together, then a committee within the office of the Secretary of Defense, the Director of Defense Research and Engineering, would resolve the problems. That was the beginning of the TFX program as a true joint program. The Memorandum provided an enforced agreement for lack of a voluntary one.[56] The following table summarizes the services' requirements.

Table 1
TFX Operational Requirements

Original Service Requirement	**Air Force**	**Navy**
Speed	1.2 Mach	1.0 Mach
SL	2.2 Mach	No Requirement
- Sustained cruise	2.5 Mach (desired)	No Requirement
Altitude Maximum		2.0 Mach
Ceiling	60,000 feet	No Requirement
Takeoff Distance	3,000 feet	No Requirement
Landing Distance	3,000 feet	No Requirement
Ferry Range	3,300 nm	No Requirement

[56] Art, 50.

Bomb Loading	No Specific	No Requirement
Gross weight	None	No Requirement
Overall Length	No Requirement	56 feet
Maximum Height	No Requirement	17 feet
Max Wind speed for catapult launch	No Requirement	+12 knots
Max Wind speed for arrested landing	No Requirement	0 knots
Loiter Time 150 nm from carrier 750 nm from carrier	No Requirement	3.5 hours 1.0 hours
Fire control/missile installation	No Requirement	System Specified

Source: Adapted from *F-111 Aircraft Performance (S).* K146.0034-18 (28 March 1963). USAF Collection, AFHRA. Document is now declassified.

The table reflects the disparity in missions that each service wanted the TFX to accomplish. The table also reflects the lack of service cooperation to determine a common set of similarly categorized requirements.

The Memorandum of September 1 also stated that changes to the Air Force version of the TFX would be kept to a minimum. This statement recognized that the Air Force was buying a larger quantity of the aircraft and therefore should have a dominant role in the acquisition. This obviously did not play well with the Navy.[57]

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[57] AFSC History, 17.

Commonality

Boeing Aircraft Company and General Dynamics (GD) were selected as the competitors for the TFX project. Secretary McNamara's demand for commonality while having minimal impact on the original Air Force design would become cumbersome. The two companies took divergent views on how to design the TFX and the lack of commonality within their designs began to show. Boeing proposed a titanium wing carry-through box to carry the loads of the swing-wing design, while GD relied on tried and tested materials in their construction. Although Boeing's design would save a lot of weight over the GD design, the titanium carry-through box had not been tested. Weight was a big concern to the Navy, as it drove many of their carrier requirements. Since the Boeing design promised more capability, it began to curry favor with the Navy and Air Force alike. The demands of carrier operations also began to take a toll on the heavier General Dynamics design. Subsystem divergencies in significant numbers forced the Air Force version to comply with carrier requirements, counter to Secretary McNamara's desire.[58] The forward equipment bay was an example of a divergent design. It was 40 inches shorter on the Navy aircraft than on the AF aircraft.[59] Of the total of 28 divergencies reported on 10 September 1962, 82 percent were to accommodate either the

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[58] *Divergent Report Proposal, TFX, Weapon System 324A, Contract AF 33 (657) – 8260 (S)* (K168.82-20, 10 September 1962, Part of TFX (F-111 Aircraft) Special Collection, AFHRA), 17. Document is now declassified. Divergencies discussed all relate to the General Dynamics designed aircraft.

[59] Ibid, 17.

Navy mission or carrier compatibility.[60] In 1963 the General Dynamics aircraft demonstrated approximately 91.4 percent commonality, as compared to Boeing's 44 percent. "The contractor (Boeing) is, in effect proposing two different airplanes from a structures point of view."[61]

The competing services, however, began to focus on the Boeing design because it offered greater promise for superior performance, even over their original requirements. Boeing's design may have been on paper only, but it was compelling. Three features made the Boeing design a better one in the eyes of the military: thrust reversers, top-mounted air inlets, and the titanium wing carry-through structure.[62] Boeing never built an aircraft to demonstrate these capabilities.[63] The civilian leadership felt that these new, enhanced performance characteristics equated to developmental and cost risk. McNamara was critical of the services' strong tendency to "overbuy" on performance that went far beyond meeting the essential military requirements. [64] The Secretary's concerns were validated by technical reports and evaluations. "Aircraft as dissimilar as

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[60] Ibid, 17.

[61] Fourth Evaluation Report, XXI A-9, quoted in *F-111 Aircraft Performance (S),* (K146.0034-18, 28 March 1963, USAF Collection, AFHRA), 3. Document is now declassified. The lack of "rules" for counting common parts and the lack of attention paid to establishing measures of "commonality" illustrated the difference in emphasis between the approach of the secretaries on the one hand and the Evaluation group and Source Selection Board on the other.

[62] Art, 124.

[63] AFSC History, 29.

[64] Art, 159.

the Boeing Air Force and Navy versions of the TFX will almost certainly tend to diverge further during design. In contrast, the GD planes are likely to retain their degree of interchangeability."[65] Concerned most of all with keeping costs to a minimum, the Secretary of Defense believed General Dynamics could deliver TFX for less money because its system promised a greater degree of commonality.[66]

Decision

To the military men, McNamara's decision to select the GD design over Boeing's was incredible. The public and the press could not believe the selection; "The F-111 was selected by Secretary of Defense Robert S. McNamara despite the recommendation of a 235-man evaluation board that a Boeing Company design be accepted."[67] McNamara chose to satisfy the requirements rather than attempt to exceed them and the risks attendant to doing so. Spending more on a weapons system than necessary to meet the military requirement meant fewer resources would be available to spend on other weapons systems to meet other military requirements. When two systems meet the requirement, it is good military judgment to select the cheaper one.[68] In McNamara's judgment, the General Dynamics version of the TFX was the best solution to the requirements delineated by the military.

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[65] *F-111 Aircraft Performance*, 4.

[66] AFSC History, 29.

[67] *Washington Evening Star*, 8 August 1966.

[68] Art, 159.

Program Cancellation

From selection of GD in 1962, three factors weighed in to propel the TFX program to cancellation in 1968: Secretary McNamara, technical, and contextual issues. Secretary McNamara, increasingly at odds with President Johnson over the prosecution of the Vietnam War, planned to leave his post to become the president of the World Bank. Technically, the Navy version of the TFX was having problems associated with carrier operations and the projected naval mission. The F-111B, affectionately called the "Sea Pig", was an excellent air-to-air systems platform, but the airframe lacked a gun, had no provision for short-range missiles like the AIM-9, and was grossly underpowered for the mission of air-to-air standoff. Carrier trials were "terrifying" to the deck hands; the aircraft tended to wallow and dip after touchdown. The aircraft was so heavy that the crew was convinced it would end up in the galley decks just below the flight deck.[69] The most serious issue, weight, had been born of the search for commonality. Attempting to adapt a land-based aircraft to carrier operations led to the addition of too much weight, thus negating its effectiveness for naval aviation. Testimony to the House and Senate Armed Services Committees highlighted the inadequacies of the design for naval operations. Both the Senate and the House eliminated funding for the F-111B in 1968. The TFX program was officially cancelled on 3 July 1968. The TFX program, however, did produce some tangible results for the Navy. Flight tests on the F-111B aircraft continued for two and a half years, during which the Navy and Grumman fine tuned the AN/AWG-9 radar and AIM-54 Phoenix missile system. This extra testing allowed the

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[69] Anthony M. Thornborough and Peter E. Davies, *F-111 Success in Action,* (London, U.K.: Arms & Armour Press Ltd., 1989) 55.

Navy and Grumman to transfer this technology and cost savings into the follow-on swing-wing fighter, the Grumman F-14 Tomcat.[70]

The Air Force now had an aircraft that did not meet its original intent. During the acquisition process, the increases in gross weight actually helped the aircraft in one of its design points: low-altitude, supersonic ingress. A beefy, heavy airframe can better withstand the buffeting of this flight envelope. The final aircraft, the F-111A, was a far cry from the short-field, highly maneuverable fighter concept envisioned by General Everest. The Air Force derived missions for the aircraft, nonetheless. The F-111A became the world's first all-weather blind bombing attack aircraft, capable of low-altitude terrain following radar (TFR) operations at high speeds. During testing in early 1967, the AF version demonstrated accuracy in this regime and in March of 1968, deployed to Southeast Asia for combat operations. Flying from Takhli AB, Thailand, Combat Lancer operations featuring the F-111A executed night, single-ship, all-weather, low altitude attacks into Vietnam. Despite the loss of three aircraft and aircrew, Combat Lancer operations were considered a success, and the F-111A became a combat proven aircraft.[71] This was the start of a long and distinguished history for the F-111. The aircraft accomplished many firsts: variable geometry wings, TFR, and a crew escape module. The F-111 returned to SEA in 1972-73 and flew over 4,000 combat missions, was central in the attacks in Libya, and flew over 2,500 combat missions during Desert

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[70] Ibid, 56.

[71] Ibid, 56.

Storm. The F-111, ultimately produced in four different variants, retired from service on 27 July 1996.[72]

Performance

The quest for commonality, driven by Secretary McNamara, forced the services to build a single aircraft that satisfied the needs of both the Air Force and the Navy. Since the Air Force planned to buy the bulk of the aircraft produced, the Secretary decreed that the requirements essential for Navy carrier operations should have minimal impact on the AF design. Adapting an aircraft designed for land-based operations to sea-based operations required many changes, as the TFX program illustrated. As the aircraft grew to meet the demands of carrier operations, its weight and performance deteriorated. For example, the aircraft was barely able to climb to 18,000 feet with a full combat load.[73] The multiple changes during the program affected both scheduling and costs.

Schedule

The development of the TFX aircraft was a difficult task. The aircraft demanded a lot of technology be integrated into one aircraft, and that one aircraft was to fulfill two separate service needs. In the quest for commonality and the projected cost savings, the development was kept to a tight schedule, regardless of the results of flight

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[72] "F-111 officially retires as the 'Aardvark'," *Air Force News,* August 1996, n.p., On-line, Internet, 14 April 2002, available from http://www.af.mil/news/aug1996/n19960805_960758.html.

[73] Thornborough, 21.

testing.[74] Technical problems plagued the TF-30 engines designed for the TFX: they failed water injection tests, afterburner flame holders experienced failures, and engine surging was a common occurrence.[75] F-111B production lagged significantly due to the myriad of changes required from the F-111A. These problems came to a head in April 1967 when an F-111*A* was to be modified and used to evaluate both engine and airframe modifications for the F-111*B*.[76] Even with the problems plaguing the aircraft, the AF signed a contract for production of 93 aircraft in 1967, as well as 84 aircraft the following year. During the next two years, the test program enjoyed some successes, and program officials regarded the F-111 engine problem resolved.[77] The test program continued in 1967 uncovered additional problems, including flap, slat, cockpit temperature, and throttle binding problems. Additionally, structural load testing revealed wing stresses that resulted in wing seal ruptures. Regardless of the nagging problems, the pressures to field the new weapon system in the Vietnam War overrode caution. After three aircraft

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[74] AFSC History, 46. General Schriever admitted to the Air Force Secretary that the engine program had been interrupted indefinitely, while the F-111A/B System Package Program was released. Unable to halt the program because of dozens of simultaneous funding and contractual commitments, the SPO had no choice but to draft a blueprint of development and production and hope for resolution of the engine malfunctions. Regardless of serious uncertainties relating to engine, weight, and commonality, all aspects of the F-111A/B continued to be bound by the early program expectations.

[75] AFSC History, 48.

[76] Ibid, 48.

[77] Ibid, 51-52.

crashed in Vietnam, operations were suspended as the Air Force attempted to discern the problems associated with the crashes. A committee called Exercise Round-Up was tasked with determining the causes for the accidents. This task was difficult given the situation in which the aircraft were lost: single-ship and unknown flight conditions. The committee recommended 11 different modifications to improve the F-111A system.[78]

During this same time, the Navy's technical problems were approaching zenith. Acceleration was less than adequate, given the weight of the aircraft and the engine problems detailed earlier. The Navy suggested an improvement program, which would seriously impact the cost and scheduling of the program. The contractor would bear all the risks and costs associated with the improvements, since the government had a fixed-price contract.[79]

The TFX schedule, upon examination, appears to be a case of the tail wagging the dog. The development of a new airframe using cutting-edge technology required an ability to build, test, evaluate, and fix the problems that would no doubt result. In a fit of self-imposed timelines, the program fielded a weapons system that was nowhere near combat-ready. Adhering to an aggressive schedule may have contributed to the loss of the three aircraft in Southeast Asia (SEA). The TFX schedule appears to have been driven by a bureaucracy that demanded commonality and cost savings, and did not realize either.

The Navy, realizing that the TFX was not going to meet its requirements, began to search for alternatives. Prior to and during the TFX program, the McDonnell-

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[78] Ibid, 54.

[79] Ibid, 56.

Douglas F-4 fulfilled the role of fleet aircraft air defense. Operational since mid-1961, the F-4 aircraft served off carrier aircraft during the Vietnam conflict with much success. The early F-4B models were replaced with F-4Js from 1968-1972, and eventually the early F-4B models were refurbished under a program called Bee Line.[80] More powerful and more capable than the Sea Pig, the F-4 allowed the Navy to remove itself from the TFX program and focus on improving a usable airframe better suited to its needs.

Costs

Secretary McNamara assumed that a joint development program would result in substantial savings. He felt that the Navy and Air Force could save the government $1 billion by building a joint-use aircraft for both services.[81] General Dynamics was awarded a contract to build 22 research and development aircraft plus 1,704 production aircraft. The Air Force was to receive 1,473 F-111As as its only tactical fighter, and the Navy was to receive 231 F-111Bs for fleet defense. For McNamara's cost savings to be met, a savings of $4.3 million per F-111B airframe was required. The total TFX program was projected at $5.8 billion ($0.7 billion for R&D and $5.1 billion for production). The average cost per aircraft was to be $3.4 million (FY63).[82]

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[80] "Service with the United States Navy," n.d., 4, On-line, Internet, 9 June 2002, available from http://members.tripod.com/~Wobert/navy.html.

[81] David S. Grantham, "The Quest for Commonality: A Comparison of the TFX and JSF Programs," (Master's thesis, School of Advanced Airpower Studies, 1997), 22.

[82] Grantham, 22.

McNamara's cost savings were never realized. No Navy F-111B production aircraft were ever built, and approximately $378 million was spent on this cancelled program. The estimated cost of the 489 production aircraft for the Air Force was approximately $16.6 million (FY70) per airframe. The estimated cost for the Navy TFX alternative, the upgraded F-4, was approximately $18 million (FY79) per airframe.[83] The TFX program was designed to save money through a common aircraft for the Navy and Air Force; it eventually provided only one third of the proposed aircraft at five times the projected cost.[84]

Conclusion

The TFX program failed to produce a common airframe for the Navy and the Air Force due to cost, schedule, and performance problems. Divergent performance requirements from the two services drove both cost and schedule problems. With soaring costs and an elongated development cycle, the Navy began to consider one of the available alternatives; the F-4. The Air Force, after many design compromises with the Navy to accommodate carrier operations, was left with an aircraft that fell short of its own design requirements. The Air Force invented missions for the aircraft, which proved very useful during the Vietnam conflict and through the remainder of the Cold War and into Desert Storm. Ironically, both the Navy and the Air Force procured significant

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[83] "Hill Aerospace Museum Images and Captions," n.d., n.p., on-line, internet, 9 June 2002, available from http://www.fortogden.com/hillafb-3.html.

[84] Grantham, 23.

numbers of F-4 aircraft, even though the system was not conceived as a joint program.[85] The McDonnell-Douglas F-4 Phantom II filled a performance niche for both services at cost and schedule they could afford and accept.

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[85] "Phantoms Phabulous Phortieth,", n.d., n.p., on-line, internet, 9 June 2002, available from http://www.boeing.com/defense-space/military/f4/. From 1958 to 1979, a total of 5,195 aircraft were built. The Phantom was the first multi-service aircraft, flying concurrently with the US Navy, Air Force, and Marine Corps.

Chapter 3

Training Aircraft

Training aircraft acquisition provide very good case studies for joint-service cooperation. The Navy and the Air Force have similar pilot training requirements, and although their pilots end up flying a variety of aircraft, the best chance for commonality is in the primary training aircraft. The following case studies of the procurement process for both the T-46 and the T-45 provide the setting for developing a joint DOD trainer roadmap.

Next Generation Trainer and the T-46

In 1979, the T-37 Tweet primary aircraft trainer had been in the US Air Force inventory for 22 years. Serious operational deficiencies and the looming obsolescence of the T-37 fleet provided the impetus for the Next Generation Trainer (NGT) program.[86] The operational deficiencies were numerous and included: lack of cabin pressurization; lack of fuel efficiency; limited range; limited weather capability; performance limitations in the traffic pattern; outdated instrument displays; excessive

[86] *History of Air Training Command,* (1982, Volume I, K220.01 V.1, IRIS No. 1055808, in USAF Collection, AFHRA), 130.

engine noise; and a limited ejection capability.[87] Moreover, the aircraft was almost at the end of its life cycle.

NGT and Specialized Undergraduate Pilot Training (SUPT) represented an attempt to reduce student pilot attrition by eliminating the questionable students before they wasted valuable resources.[88] After the Department of Defense granted approval for NGT in June of 1979, the Air Force's Aeronautical Systems Division (ASD) solicited proposals from companies to replace the T-37.[89] The procurement plan established a projected buy of approximately 650 aircraft: 483 for Undergraduate Pilot Training (UPT), 38 for Undergraduate Navigator Training (UNT), 43 for Accelerated Copilot Enrichment (ACE), and 86 for Euro-NATO Joint Jet Pilot Training (ENJJPT). The projected production of 3,557 aviators each month based on an individual aircraft utilization rate of 60 hours of flying dictated the procurement figures.[90] By October 1981, five companies (Cessna, Ensign, Fairchild Republic, Gulfstream American, and Rockwell) had demonstrated interest and the request for proposal (RFP) was released in October 1981. On 2 July 1982, Secretary of the Air Force Verne Orr announced that

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[87] *ATC History*, 130, and, *Report 83-1: T-46 Aircraft Requirements,* (Air Training Command, 31 December 1983, IRIS No. 1090123, MICFILM 42230 (on microfilm only), frame 1590, in USAF Collection, AFHRA), 6-8.

[88] *ATC History*, 130.

[89] Ibid, 130.

[90] Report 83-1, 1,3.

Fairchild Republic and Garrett Turbine Engine Company would team as contractors. The NGT would be designated the T-46A.[91]

Compared to the T-37, the T-46A would have increased performance, improved maintainability, reduced fuel consumption, lower operating costs, and improved capability to operate in adverse weather. If the design for the T-46A as proposed by Fairchild Republic performed as expected, it would have met or exceeded all of the required performance standards set out in the proposal.[92]

Program Costs

The NGT program started off poorly. In the first year estimated program costs increased $164 million, or 5 percent of the expected $3.277 billion. The increase was due to two factors: the production schedule was stretched into FY 1984 funding and higher escalation indices were used to project the effect of inflation. Although the program would have cost about $82 million more, the Air Force transferred the aircraft simulator development to another program, deleted development aircraft, and canceled plans for one phase of engine testing.[93] The Air Force planned to develop a new engine in parallel with the T-46A airframe by adopting the technology of an existing but larger commercial engine. The performance demanded of this engine was high, and the Air Force only

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[91] *ATC History*, 36.

[92] Ibid, 131.

[93] *Air Force and Navy Trainer Aircraft Acquisition Programs,* (USGAO Report GAO/MASAD 83-22, 5 July 1983, K146.6203-18 in USAF Collection, AFHRA) 13. Hereafter referred to as AF GAO.

allowed 33 months for the development of the new engine. Historically, adequate development of modified engines requires five to seven years.[94]

Schedule

The Air Force considered the T-46A to be within the state-of-the-art and low complexity in its components. Consequently, the acquisition program included no demonstration/validation phase. The program office officials expressed confidence that the airframe, as well as the engine, would be developed in time to meet the program objectives. In fact, in order to save money, the Air Force deleted the fourth phase of engine testing, resulting in engine tests encompassing only one-half of an engine lifetime.[95] The acquisition program provided for considerable overlap between development and production. Any delay in the development schedule or problems identified in the flight test program would have resulted in the need to make changes in the aircraft or its engine after production was underway.[96] For example, the decision to exercise the option for the first lot of at least 10 aircraft was scheduled for January 1985, four months before the first flight of the aircraft. The deadline to exercise the option for the next 22 aircraft was December 1985 and delivery of another 26 production aircraft would happen before the conclusion of flight testing.[97]

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[94] AF GAO, 19.

[95] Ibid, 18.

[96] Ibid, 14.

[97] Ibid, 19.

Navy Involvement

In accordance with a Memorandum Of Understanding (MOU) with the United States Navy, one Naval officer participated in the T-46A source selection, and the overriding concern was whether or not the T-46A would meet the Navy's primary flight training requirements. The Navy thought that, in general, the T-46 would be acceptable for the Navy's use as a primary trainer. At the time, the Navy saw no need to replace its much less expensive T-34C ($1 million vs $5.1 million for the T-46A). If the Navy acquired the T-46A, the overall unit cost of the new aircraft would decrease because of the increased economies of scale based on an increased production run that spread out the developmental costs. However, these economies came at an increased cost for the Navy. Among these changes, the naval instrument cluster, pilot ejection seat, and a new training syllabus were required to accommodate the T-46A's higher performance.[98]

The program, however, was not merely an Air Force venture. The ENJJPT and ACE programs were run by two different organizations. NATO allies ran ENJJPT and would have to coordinate on the requirements. Strategic Air Command (SAC) managed ACE as a tool to enhance their pilot's experience level without using costly bomber sorties to gain hours. The T-46A aircraft held great promise for producing a trainer aircraft with superlative performance qualities. Unfortunately, none of the three organizations would get the chance to fly the aircraft.

Program Failure

In September 1986, Secretary of the Air Force Edward C. "Pete" Aldridge, Jr. intimated that the contract for the T-46A should not be renewed and the program

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[98] AF GAO, 20.

should die a slow death. Secretary Aldridge confirmed the need for Congress to not appropriate funds for the contract and then allow the contract officers to negotiate an appropriate settlement with Fairchild Republic and Garrett. This move essentially killed the program.[99] Why did such a promising program get terminated within 4 years of beginning? There were multiple causes for the failure.

During the contract negotiations, the Air Force demanded overlapping both development and production of the aircraft. This was a very aggressive stance for the procurement of both a completely new aircraft and a new engine design.[100] The AF decided to accept 26 aircraft before flight testing was even completed. The Air Force also massaged the production schedule to keep the program within expected funding limits.[101] One trick employed by the Air Force was moving some of the costs of the program (engine testing and simulator development) out from underneath the T-46A "umbrella." At the beginning of the contract, there was no commercially available engine that could be used for the T-46A. Therefore, the Garrett Turbine Company had to develop an engine within 33 months, a feat that the Garrett people felt they could accomplish. However, Garrett included time for testing after production had already begun. The evidence shows that both Garrett and Fairchild Republic may have used this

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[99] E. C. (Pete) Aldridge, Jr., Secretary of the Air Force, Memorandum, For Secretary of Defense, the Department of Defense, Subject: T-46 Program – INFORMATION MEMORANDUM (19 September 1986. 168.7272-11, IRIS No. 1097781, 2-30 September 1986, in USAF Collection, AFHRA).

[100] AF GAO, 13.

[101] Ibid, 17.

contract to shore up ailing corporations in a vain attempt to save them both. After contract award in July 1982, many observers suspected that Fairchild-Republic agreed to this aggressive strategy because the company's A-10 aircraft was nearing the end of production and the Republic SF-340 was also having major production problems.[102]

Republic made a major mistake in early 1985, when the T-46A was unveiled. By all appearances, a beautiful aircraft rolled out on 11 February 1985, but the Air Force staff was "horrified" to discover the aircraft lacked over 1,200 internal components and some skin sections were fabricated out of fiberglass and made to look like finished sheet metal. The discovery of this trickery soured relations between the company and the Air Force. Secretary of Defense Weinberger invoked a rarely used contractor review to ascertain what was wrong at Fairchild Republic.[103]

In 1985, a Contractor Operations Review (COR) team went to the Fairchild Republic plant in Farmingdale, NY to evaluate the overall effectiveness of Fairchild's management systems and their ability to meet contractual requirements.[104] The review identified 279 findings in the eight functional areas reviewed. In response to the COR, Fairchild implemented actions to correct the items reported and identified 7 underlying causes:

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[102] Joshua Stoff, *The Thunder Factory: An Illustrated History of the Republic Aviation Corporation* (Osceola, WI: Arms & Armour Press, 1990) 183.

[103] Ibid, 188.

[104] *History of the Air Force Flight Test Center,* October 1984 - September 1987, Volume X, (K286.69-42, V. 10, IRIS No. 1087192, in USAF Collection, AFHRA), Appendix II, 21.

High turnover rate of senior management and organizational changes

Reduced reinvestment levels in recent years in plant facilities, equipment, and centralized capabilities.

Deteriorated employee morale and dedication in recent years

Inadequate emphasis on quality, safety, and schedule in some products and systems

Failure at most levels in the work force to meet productivity targets.

Optimism in forecasting, particularly in new program proposals, causing overruns and schedule delays from the onset.

Failure to follow management development and succession plans.[105]

In spite of the company's problems, the T-46A aircraft initially met or exceeded expectations, but Fairchild could not meet its contractual obligations. In FY87, Congress did not appropriate funds for the NGT program, and the T-46A program ceased to exist.

Alternatives

The T-46A program held significant promise to improve Air Force training aircraft. Besides replacing the aging T-37 aircraft, the T-46A would have saved the Air Force over $120 million per year in operations costs alone.[106] After 4 years however, the Air Force found itself without a new trainer and no replacement on the horizon. Why did this happen?

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[105] Ibid, 21.

[106] 83-1, 20.

The three factors of cost, schedule and performance weighed heavy on the T-46. The performance demanded of the developmental aircraft was attainable using within-state-of-the-art technology. But was all that performance really necessary? The Joint Primary Training System (JPATS) is a slower, tandem, turboprop aircraft, and the Air Force is currently buying it to replace the T-37 fleet. Did the Air Force really need the T-46A? At that time, the answer was yes. The T-37 fleet entered service in 1956 with a projected life of 25 years.[107] The aircraft had already been extended past its designed 18,000 hour service life. When the T-46 program was cancelled, the Air Force had to quickly devise a plan to extend the service life of T-37 aircraft until a replacement trainer could be developed. This plan was called the T-37 Structural Life Extension Plan (SLEP). SLEP was not to correct any operational deficiencies nor was it to provide any enhancements. The program sought only to replace those fatigue-critical components necessary to maintain the airworthiness and flight safety. The approximate cost per aircraft was $300,000 with a total program cost of nearly $200 million. Program funding began in FY88 and was essential to avoid a massive grounding of the T-37 fleet in 1991.[108] The bottom line for the Air Force was that it was extending its already aging fleet for $300,000 per aircraft versus paying $5.1 million per aircraft for a new trainer. Performance was not the reason for the termination of the NGT program.

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[107] *Staff Historical Report: Air Training Command, DCS/Logistics(LG),* 1 Jan 1986 to 31 Dec 1987, (IRIS No. 1090097, MICFILM 42229 (on microfilm only), frame 1117, in USAF Collection, AFHRA), frame 1124.

[108] TAMP, 1-9.

So why did the NGT program get cancelled? The answer lies in the cost and schedule overruns, along with personality conflicts between the Department of Defense and Fairchild Republic. The inadequacies of the design and production team at Fairchild caused costs to increase almost immediately. The schedule also slipped as the aircraft's design problems mounted, culminating in the "faked" rollout. The rollout was the beginning of the end for Fairchild Republic as a defense contractor; the Secretary of the Air Force and the Secretary of Defense were not pleased with the attempted shenanigans. With the rarely invoked contractor review, the Secretary of Defense set the tone for the eventual downfall of the both the program and the company.[109] Cost and schedule overruns forced the Department of Defense to make a budgetary decision for FY87: with the end of the Reagan era of high defense spending in sight, the Air Force decided that the T-46 was low on its list of priorities and it could be eliminated.[110]

The Navy, however, was focused on an advanced trainer. Their VTXTS (Undergraduate Jet Flight Training System) became the T-45 Goshawk. Although occupied with procurement of the T-45, Navy representatives, operating under the terms of their MOU with the Air Force, monitored the development of the T-46A. The Air Force performed the same role for the Goshawk. Both services evaluated each aircraft's compatibility with their unique training requirements even as they both went ahead with procuring their own aircraft.

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[109] *Thunder Factory*, 188.

[110] Ibid.

VTXTS and the T-45 Program

To replace the T-2 and TA-4J systems in the intermediate and advanced training phases the Navy developed VTXTS as an integrated pilot training package. By replacing two legacy systems, the VTXTS could reduce escalating flight training costs and ensure effective training into the 1990s and beyond after the TA-4J completed its service life.[111] As of October 1982, the Navy had an inventory of 304 TA-4Js. Of these, 175 were allocated to strike pilot training. The balance was used for other programs such as Naval Flight Officer Training, the reserves, and other training programs. Navy officials said that the first priority for use of TA-4Js was strike pilot training and that the other programs would be curtailed within limitations, if necessary, to provide the TA-4Js for strike pilot training. Sufficient aircraft were available in the Navy inventory to maintain strike pilot training until at least 1990. Navy projections show that by 1987, upon delivery of the first T-45B, the Navy would already have had to transfer at least 39 TA-4Js from other programs. Based on Navy projections, there was an adequate number of TA-4Js for strike pilot training until FY95 if all TA-4Js could be used for strike pilot training and if the TA-4J service life was extended to 12,000 flying hours.[112] The Navy published a Request for Proposals (RFP), and received six responses. Unfortunately, the Navy did not budget enough funds in FY83 to support two competing contractors. McDonnell-Douglas and its partner, British Aerospace (BAe), were selected as the

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[111] AF GAO, 5,9.

[112] Ibid, 9.

winner over five other entrants. Its derivative design, based on the extant BAe Hawk, was projected to have the lowest life-cycle cost and a shorter contractor flight program.[113]

The British Aerospace Hawk, already a well-established land-based primary jet trainer in the Royal Air Force, was also a trainer for several other air forces. The Hawk was a multi-purpose trainer/light ground-attack aircraft developed for various European countries during the 1970s. The Navy believed that Hawk could be adapted to its training role with minimum modification.[114]

Program History

In October 1984, the Navy awarded a firm fixed-price contract to the Douglas Aircraft Company, a component of the McDonnell-Douglas Corporation, for full-scale development of the T-45 system. The $5.2 billion contract, finalized in May 1986, included production of two aircraft for research and development flight testing, and a total buy of 282 aircraft.[115] Nearly a year after the initial production commitment, the program conducted its first flight tests and suffered a major setback. The Naval Air Test Center (NATC) declared the aircraft operationally unsuitable because 24 detected deficiencies compromised safe flight. These deficiencies forced the Navy to not obligate

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[113] AF GAO, 5.

[114] Federation of American Scientists, "T-45 Goshawk," n.d., n.p., on-line, Internet, 14 April 2002, Available from http://www.fas.org/man/dod-101/sys/ac/t-45.htm

[115] *T-45 Training System: Navy Should Reduce Risks Before Procuring More Aircraft*, (USGAO Report GAO/NSIAD-91-46, 14 December 1990), 9. Hereafter referred to as Navy GAO.

funds for further production until they were corrected.[116] Due to the concurrent nature of the testing and production of the aircraft, these actions increased the cost of the program by approximately $72 million.[117]

Similar to the T-46A program, the Navy tailored the program to accommodate what it perceived as unique circumstances. The Navy also believed the system could be fully operational no later than FY91 because the service assessed the technical risks as only low to moderate.[118] If the development of the derivative aircraft went smoothly, production and deployment of the system would be expedited. If major technical problems surfaced, the costs and development time would almost certainly escalate. As recognized during the initial flight testing, adapting the Hawk design to the T-45 mission proved more challenging that either the Navy or the contractor envisioned.[119] Since World War II, no U.S. fighter or attack aircraft bought by both the Navy and the Air Force initially developed to operate from land bases was subsequently adapted to operate from carriers. The problem is that aircraft designed for carrier operations have special design requirements: tail hooks and reinforced structures for catapult takeoffs and arrested landings, slower approach speeds, and more precise flight control during approaches. All of these considerations add weight and alter the aerodynamic qualities

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[116] Navy GAO, 10.

[117] Ibid, 12.

[118] Reference footnote 26: the Navy never did accomplish a service life extension program on the TA-4J aircraft.

[119] Ibid, 15.

when retrofitted onto a land-based aircraft.[120] These key factors would weigh in on the Air Force's decision to participate in the T-45 program.

Air Force Involvement

During the late 1980s, the Air Force planned to rework its training aircraft requirements. After the T-46A debacle failed to provide a replacement for the T-37, the service needed to devise a plan to fulfill its future pilot production requirements. The Air Force and Air Training Command (ATC), limited by availability of airframes, had a very thin margin for error in the area of pilot production. To meet the demand for training aircraft, the Air Force transitioned to a dual-track system to extend the service life of T-38s, acquired a missionized, non-developmental business jet for advanced training of students in the Tanker Transport Training System (TTTS) track, and extended the life of the T-37s with a Structural Life Extension Program (SLEP) to permit the jet to fly into the first decade of the 21st century.[121] Because of these organizational and technical adjustments, the Air Force no longer had a requirement for the T-45. Compared to the T-38, the T-45 possessed significantly reduced performance. Intended to train aircrews for carrier operations with the appropriate performance characteristics, the Air Force did not want to handicap its pilots with the under performing T-45. The chart below compares the T-38 and the T-45.

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[120] Ibid, 16.

[121] Department of Defense 1989 Trainer Aircraft Masterplan, (DTIC document AD-B132 069, 15 February 1989) ix.

Table 2
Advanced Trainer Aircraft Comparison

	T-38	T-45
Thrust to Weight	.65	.43
Wing Loading (KG/M^2)	345	302
Max Speed (Mach)	1.2	.85
Approach Speed	155 Kts + fuel	125
Roll Rate (degrees/sec)	720	360
G-limits (Symmetric)	+7/-2.9	+7.3/-3
Sustained G (15K MSL)	4.7	3.4
Mission Fuel (Lbs/Hr)	2600	1537
Maintenance Man Hours/Flying Hour (MMH/FH)	8.0	10.0

Sources: Adapted from Department of Defense 1989 Trainer Aircraft Masterplan, (DTIC document AD-B132 069, 15 February 1989) ix.

Not only was the T-45 deficient in performance, its overall service costs would have been comparable to the T-38 because the higher MMH/FH costs would offset the fuel savings.[122] But comparable operating costs hardly offset the initial unit cost of new aircraft purchases and the Air Force could not justify procurement of an inferior aircraft.

Conclusion

The Navy experienced its own growing pains in the T-45 program. As the service attempted to adapt a land-based aircraft to carrier service, it experienced the problems associated with foregoing a developmental phase to ensure the production

[122] Ibid, 4-4.

aircraft would meet all its requirements. Modifying an aircraft can provide challenges that may exceed the costs of developing a brand new aircraft. The Hawk appeared to provide an excellent baseline aircraft to develop the T-45 Goshawk. Flight tests revealed otherwise and the Navy experienced significant cost growth and schedule slippage. Although the program had a rocky beginning, the T-45 achieved initial operational capability (IOC) in 1991 and currently serves with the Navy as its advanced jet trainer. The success of the program lies in its integrated training system (302 aircraft, 32 flight simulators, instructional materials and equipment, training integration systems, and logistics support).[123]

Although the T-45 program did not suffer the same fate as the T-46, it had its share of problems. Even with those problems, the T-45 did not get cancelled. The question, then, is why? The answer lies within cost, schedule, and performance.

While the performance of the T-45 allowed the Navy to replace an aging fleet of TA-4Js and T-2s, the transition from land to carrier operations proved more difficult than expected. The number of modifications and adjustments required to make the Hawk into the Goshawk forced increased costs and schedule slippage. The Navy was willing to accept the sliding schedule; it could make do with its current inventory of aircraft while the bugs were ironed out of the T-45 program. DOD was also willing to accept the scheduling slips due to the demonstrated efforts of the contractor and the Navy to incorporate the changes in the aircraft design. According to a GAO report issued in December 1990, the DOD did not concur with the suggestion that Congress not appropriate funds for additional T-45A aircraft in FY91 (the year the aircraft achieved

[123] Navy GAO, 2.

IOC). DOD was confident that the aircraft deficiencies would be satisfactorily overcome with modifications verified in operational tests and approved the next production lot.[124] The T-45 program was kept alive even with concurrent development and production risks. The program enjoyed unrivaled support from both the Navy and DOD. Even in the face of GAO non-concurrence, one must conclude that in this case the Navy had no reasonable alternative.

As evidenced by the training aircraft discussed, concurrent development of aircraft hinders correcting identified deficiencies within budgetary and scheduling constraints. As the services evaluated both programs for use, the Navy and the Air Force came together in 1989 to devise a training aircraft roadmap. The DOD Training Aircraft Masterplan (TAMP) specifically identified when joint-service acquisition may have been justified. TAMP stated that "the key to joint-service acquisition, then, is joint specification of requirements far enough in advance to meet the projected needs of the parties involved…Joint specification of requirements and timing are key to the process."[125] This roadmap would serve as the starting point for developing the Joint Primary Aircraft Training System (JPATS).

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[124] Navy GAO, 29. The GAO did not believe that testing scheduled for completion in FY91 could reduce technical risk sufficiently to warrant additional commitment to T-45A procurement. Development of a new wing for the T-45 was one of the major corrective actions instituted in the wake of the deficiencies discovered in 1988, and the Navy did not expect to receive delivery and begin testing of an aircraft fitted with the new wing until FY92.

[125] TAMP, 4-1.

Chapter 4

Joint Primary Aircrew Training System (JPATS)

The T-6A Texan II aircraft is the safest, most cost-effective, joint primary pilot training tool available in the free world today.
Colonel Toni Arnold
Director, Flight Training SPO,
Aeronautical Systems Center

In 1988, the Navy and the Air Force were at a unique moment in history. At this time, the services could capitalize on a situation, work together, and provide a cost-effective solution to pilot production, specifically primary training. Both services needed a plan to modernize their fleets of training aircraft. After careful evaluation, the two services agreed to acquire six aircraft systems to produce pilots for the next 20 to 30 years.[126] The Air Force would buy the Tanker-Transport Training System (TTTS), the Primary Aircraft Training System (PATS), and the Bomber Fighter Training System (BFTS). The Navy would purchase the T-45 (VTXTS), PATS, and Strike Training System (STS). The Air Force and Navy had already signed a Memorandum of Understanding (MOU), demonstrating their intent to jointly specify requirements for TTTS/Naval Flight Officer Training System (NFOTS), USN and USAF PATS, and BFTS/STS. The Air Force, in support of TTTS, would procure modern, missionized business jets between 1990 and 1997.[127] The Air Force would replace its current BFTS

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[126] *Department of Defense 1989 Trainer Aircraft Masterplan*, DTIC document AD-B132 069, 15 February 1989, 4-7. Hereafter referred to as TAMP.

[127] TAMP, 4-12.

system, the T-38, in the 2005-2015 timeframe. The BFTS would be capable of pulling high-G forces for a sustained period of time, have a cockpit layout representative of 21st century fighters, and could have variants compatible with both the Air Force and Navy training environment.[128]

The PATS would replace the T-37, with deliveries from 1997 to 2004. PATS would be a modern, non-developmental primary trainer compatible with both training environments. In 1988, the Air Force and Navy established a Joint PATS committee to work toward joint specification of requirements. Discussions between the staffs of ATC and the Navy's OP-59 over the composition of the requirements document demonstrated a great willingness on behalf of both services to compromise, cooperate, and reap the benefits of joint-service acquisition.[129]

The requirements, broad in scope, were designed to lead to a Statement of Need, to be issued later. The system requirements included:

An integrated training system (ground based trainers (GBT), aircraft, training management system, etc.).

Must meet Air Training Command (ATC) and Chief of Naval Air Training (CNATRA) syllabi constraints.

Operate out of ATC/CNATRA airfields and airspace.

Pressurized aircraft.

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[128] Ibid, 4-13.

[129] Ibid, 4-13. The Trainer Aircraft Masterplan provides a very detailed overview on all the options associated with the selection of acquiring these systems.

Zero/Zero ejection/extraction seat.[130]

Programmable/selectable flight instrument system.[131]

The Air Force and the Navy cleared the first major hurdle on the subject of commonality. Each service preferred a divergent seating configuration. The USAF preferred the side-by-side configuration, while the USN preferred the tandem configuration. These preferences may have been due to each service's previous experience in training aircraft. The T-37 is a side-by-side configuration, while the T-34C is a tandem arrangement. The hurdle was cleared when both services agreed on the tandem configuration for the following reasons:

Symmetric flight references[132]

Wider field of view

Lower relative form drag

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[130] A zero/zero ejection seat allows the aircrew to eject at 0 knots groundspeed and at 0 feet elevation above ground level (AGL). The T-37 seat is a 100 foot AGL and 120 knot seat, which put the aircrew out of an ejection envelope during most traffic pattern training. The T-34C does not have an ejection seat.

[131] *History of Air Training Command*, 1 January 1989 to 31 December 1989, Volume XII, K220.01 V.12, in USAF Collection, AFHRA, SDIII-55. Hereafter referred to as *ATC History 1989.*

[132] The student pilot will have the same references outside the aircraft from the front cockpit position. In a side-by-side configuration, the student pilot can be limited to performing left-hand patterns only, thus limiting the amount of training and potentially limiting the airfields facilities due to considerations such as quiet hours, etc.

Similarity to high-performance cockpits

Increased perception of independence[133]

By clearing this first hurdle of "commonality," the Air Force and the Navy demonstrated an ability to work together towards joint acquisition.

Change of Administration

In 1992, the Chief of Staff of the Air Force, General Merrill A. "Tony" McPeak questioned whether or not the Air Force should continue with the integrated training system. In a memo to the DOD Under Secretary for Defense for Acquisition (USD(A)), the CSAF was concerned about the recent change in political leadership and was searching for support to either continue the program or split it up into two separate tracks (i.e. aircraft and training system separately).[134] The Authorization Conference Committee in Congress did not want to change the acquisition strategy or plan. They felt that the strongest feature of the current JPATS acquisition plan stemmed from the efficiencies provided by procurement of an entire integrated system. "It is shortsighted to procure only replacement aircraft for the Air Force and Navy primary training and not

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[133] *ATC History 1989*, SDIII-56.

[134] Gen Merrill A. McPeak, Chief of Staff, United States Air Force, memorandum to Under Secretary of Defense for Acquisition, Mr. Deutsch, subject: JPATS – ACTION MEMORANDUM, 18 March 1993, K168.03-1405, 1 January – 31 December 1993, in USAF Collection, AFHRA.

upgrade the instruction 'system' in the process."[135] The Conferees directed the DOD to proceed with the JPATS procurement under a non-developmental, single integrated procurement contract. The JPATS program remained a joint acquisition project.

Non-Developmental Acquisition

The T-46A program was a developmental program. This type of program requires industry to develop the aircraft desired by the services. The costs associated with developing any new technologies: testing, fabrication, and certification, are all rolled into the cost of the aircraft when it's delivered to the service. By using a non-developmental acquisition strategy, the services would be using commercial off-the-shelf (COTS) technology. The JPATS program took this one step further, and required that the proposal aircraft be government-quality airworthy at the time of delivery. This meant that the baseline aircraft had to have an acrobatic civil certificate issued by the FAA or an equivalent military qualification.[136] After the proposal was accepted and a contractor selected, the aircraft delivered would be fitted with equipment that would "missionize" the aircraft. The additional equipment/modifications were military-specific and normally not used in the civilian world. The types of equipment or modifications associated with this deliver included ejection seats, improved airframe durability, and bird strike resistance.[137]

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[135] Ibid.

[136] *History of Air Training Command*, 1 January 1992 to 30 June 1993, Volume XVII (K220.01 V.17, in USAF Collection, AFHRA), SD V-30. Hereafter referred to as *ATC History 1992.*

[137] *ATC History 1992.*, SD V-30.

Operational Requirements Document (ORD)

The Operational Requirements Document (ORD) lays out requirements asked for by the services. In the T-46A program, the ORD development was very disjointed and oftentimes confusing. Lack of consensus during the T-46 requirements process led to a demanding ORD, and may have caused the ultimate failure of the program.[138] The JPATS team apparently learned from the T-46A experience. The ORD developed by the team consisted of fourteen key parameters. Thirteen of the key parameters applied to the aircraft and one applied to the Ground Based Training System (GBTS). See Table 3 for more details.

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[138] Col Stephen D. Chiabotti, SAAS Commandant, interviewed by author, 5 February 2002.

Table 3
JPATS Key Parameters

Key Parameters	Threshold	Objective	Demonstrated
Syllabus Maneuvers and Mission Profiles (Contact/Familiarization, Instruments, Formation, Navigation-High and Low, Training Mission Accomplishment)	Accomplish all 5 mission profiles	Same	Accomplish all 5 mission profiles
Operational G Envelope (Gs)	+6 to –3 +4 to 0 asymmetric	+7 to -3 +4 to 0 asymmetric	+7 to -3 +4 to -1 asymmetric
Sustained Speed (1000 Ft MSL, hot day)	250 KTAS (270 KTAS Dash)	270 KTAS	250 KTAS (270 KTAS Dash)
Ejection Seat Envelope with Survival Kit	0 Ft - 60 Knots (KTS)	0 Ft - 0 KTS	0 Ft - 0 KTS
Pressurization (PSI differential)	3.5 PSI Diff	5.0 PSI Diff	3.5 PSI Diff
Able to Perform An Engine Out Landing	To Runway	Unprepared Surface	Demonstrated to Runway
Birdstrike Capability (4 pound bird, no catastrophic damage)	270 KTAS	Max low level A/S	270 KTAS
Cockpit Seating Configuration	Stepped Tandem	0 degree over-the-nose visibility from the rear cockpit at design eye height	Stepped Tandem
Anthropometric Accommodation (Sitting height)	32.8 to 40 inches	31 to 40 inches	31 to 40 inches
Cockpit Configuration	Able to be operationally flown from either cockpit	Interchangeable Instructor/Student	Interchangeable Instructor/Student
Takeoffs/Touch & Go/Land (Wx, weight, configuration) at Main Operating Bases	5000 Ft Runway	4000 Ft Runway	4000 Ft Runway
Exterior Noise	FAR Part 36, Most Restrictive Applicable Standard	Same	FAR Part 36, Most Restrictive Applicable Standard
IFR Certified Instrumentation	IFR Certified	All digital except	IFR Certified

Key Parameters	Threshold	Objective	Demonstrated
	(Selectable EADI/EHSI)	backups	(Selectable EADI/EHSI)
Visual System for IFT/OFT	Provide a visual field of view commensurate with the JPPT syllabus training requirements	Same	Provide a visual field of view commensurate with the JPPT syllabus training requirements

Source: Single Acquisition Management Plan (SAMP) for the Joint Primary Aircraft Training System (JPATS), Milestone III, 5 October 2001, on-line, Internet, available from https://www.asc.wpafb.af.mil/asc/yt/jpats/t6homepage.htm.

During program review in July 1993, the Under Secretary of Defense for Acquisition and Technology (USD (A&T)) approved a single contract strategy with two stipulations. The first stipulation limited acquisition costs to the greatest extent possible and the second ensured that JPATS was fully consistent with DOD's policies on women in combat. The services would ensure that equal percentages of eligible populations of men and women, but not less than 80 percent of female college graduates were accommodated by JPATS.[139]

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[139] Single Acquisition Management Plan (SAMP) for the Joint Primary Aircraft Training System (JPATS), Milestone III, 5 October 2001, on-line, Internet, available from https://www.asc.wpafb.af.mil/asc/yt/jpats/t6homepage.htm) 4. The Clinton administration had recently taken over and was dealing with issues that resulted from the Navy's Tailhook scandal. With the new policy of women in combat, all training systems needed to be compliant.

Selection Process

The JPATS selection process began on 18 May 1994, when the RFP was issued.[140] Seven contractors responded to the JPATS RFP: Beech-Raytheon, Cessna, Grumman, Lockheed, Northrop, Rockwell, and Vought.[141] According to the Federation of American Scientists, this was one of the longest and most closely scrutinized competitions ever. The process took fourteen months and entailed evaluations of seven aircraft, seven cockpit mockups, and thousands of pages of contractor proposals.[142] Raytheon, with a modified Swiss Pilatus PC-9 aircraft, was awarded the prime contract on 22 June 1995.[143] The contract contained a nine-year period of performance through FY2004, and a production run continuing through FY2017. Concurrent with the contract award, Raytheon Aircraft Company (RAC) was also provided the GBTS Request for Contract Change Proposal (CCP). In April 1997 RAC announced that Flight Safety Services was the GBTS subcontractor, and would work with the prime contractor, RAC.[144]

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[140] Federation of American Scientists (FAS), "T-6A JPATS [Texan II/Harvard II]", n.d., n.p., on-line, Internet, 9 June 2002, available from http://www.fas.org/man/dod-101/sys/ac/t-6.htm.

[141] *History of Air Education and Training Command*, 1 July 1993 - 31 December 1995 (Vol XIII, K220.01 V. 13, in USAF Collection, AFHRA), III-83, p. 6

[142] FAS, n.p.

[143] Transcript of DoD News Briefing, 22 June 1995, Dr. Sheila E. Widnall, SECAF, et al, on-line, Internet, 25 February 2002, available from http://www.defenselink.mil/news/jun1995/t062395_tjpats.html.

[144] SAMP, 4-5.

Program Updates

As with any program, JPATS experienced some perturbations during the life of the program. From May 1996 to April 2000, the number of air vehicles increased from 711 to 782 and requirements for the simulators from 109 to 122.[145] In pricing their proposal, RAC had counted on significant foreign sales to keep production prices down. However, these foreign sales never materialized, and the unit cost of the aircraft increased to $4.4 million (FY01). In July 2000, Secretary of the Air Force Acquisitions (SAF/AQ) formed a Joint Estimating Team (JET) to identify and investigate alternatives to reduce projected increases in aircraft cost for production. The JET identified opportunities for savings that combined potential to decrease the unit cost to as low as $3.9 million per aircraft (FY 01).[146]

Non-developmental?

JPATS consists of the air vehicle (T-6A Texan II) and the GBTS (which consists of aircrew training devices (ATD), computer based training system (CBTS), training integration management system (TIMS), and logistical support). Since all the support assets for the T-6A did not exist, the GBTS was developmental. The air vehicle, however, was not developmental.[147] Drawing on lessons learned from the T-3 Firefly program, the Air Force Flight Test Center determined that non-developmental commercial acquisition programs still required a thorough test of the aircraft before

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[145] Ibid, 5.

[146] Ibid, 5.

[147] History of the Air Force Flight Test Center, January - December 1998, Volume XI, K150.01 V. 11, in USAF Collection, AFHRA, SD 3-101, 5.

acceptance and delivery.[148] The test planning for the aircraft focused primarily on FAA safety issues. The bulk of testing required that the service test pilots evaluate the mission suitability for training military students, which included: expanded spin/departure characterization, normal and emergency procedures, and workload assessments. Some issues that hampered the test process included: military data reduction methods, instrumentation, and test techniques, and conducting test flights at the contractor's location (Wichita, KS). Wichita has poor airspace, seasonal weather, and lacks other specialized assets like dry lakebeds.[149]

For the T-6, numerous modifications were planned from the existing PC-9 design:

pressurization

new engine (from 950 shaft horsepower (SHP) to 1100 SHP)

new four-bladed prop

increased weight (25-30 percent)

new ejection seats (0/0 from 0/60)

redesigned canopy and all new fracturing system (shape and weight for bird strike protection)

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[148] After many accidents, the T-3 was subsequently removed from service in October 1999. The T-3 was a commercially acquired non-developmental program. T-3 acquisition provided some lessons learned for follow-on programs to draw from.

[149] *History of the Air Force Flight Test Center*, 1 October 1997 - 30 September 1998, Volume XXV of XXXIV, K286.69-42 V.25, in USAF Collection, AFHRA, SD IV-E-21

changes to control stick, rudder pedals, and elevator downspring

addition of stall strips on leading edge

slight change to wing incidence angle

10. changes to horizontal/vertical tail to improve control forces/stability

add new trim aid device

changes to cockpit to accommodate new anthropometric[150] standards

changes to cockpit instrumentation and arrangement

beefed up structure

new wing leading edge design for birdstrike repair

new landing gear (allow landings up to 13 feet per second descent rate) (Navy requirement)

installation of On Board Oxygen Generation System (OBOGS)

new fuel system and tank arrangement

liquid crystal cockpit displays[151]

The transition of the PC-9 to the T-6A was not going to be an easy one. In fact, the T-6A military production aircraft has no part number that was original to the civilian PC-9 aircraft. In essence, the services redesigned the aircraft.[152] With the numerous changes described above, the program turned into a developmental program.

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[150] Changes to cockpit environment to accommodate approximately 80 percent of female population.

[151] *AFFTC History*, Oct 97-Sep 98, SD IV-E-21.

[152] Phone interview with Bob Laymon, RAC, February 2002.

These changes culminated in an approximate schedule slip of 12 months for the program. The program was to achieve IOC by May 1999, but the first squadron did not hit IOC until May 2000.[153]

Production

The program is currently in the final stages of Manufacturing Development (MD) and concurrently in low rate initial production (LRIP) while RAC gears up for full-rate production. To date, acquisition of 168 aircraft has been authorized in LRIP. The Multi-Service Operational Test and Evaluation (MOT&E) of the aircraft and the in-plant MOT&E have been completed, and field MOT&E of the GBTS is expected in the FY01/02 timeframe. These actions supported a June 2001 IOC at Moody AFB, GA, and an August 2003 IOC for the Navy. Acquisition is scheduled to continue through 2014 with the last delivery expected in 2017.[154]

Funding

The Air Force and the Navy both provide funding for the JPATS program. The Air Force has the program planned out to FY07 with an acquisition of 454 airframes. The Navy, however, had only planned out funding until FY01, according to the Single Acquisition Management Plan (SAMP), dated 5 October 2001. The funding for FY01 was removed during the budget process, and FY01 was unfunded. The Navy's apparent lack of commitment to the program is curious. As of July 2001, both the SAMP and the

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[153] SAMP, B-3.

[154] SAMP, 6.

Navy budget reflect no funding from FY01 to FY07. This lack of commitment also caught the eye of Congress. The House and Senate Armed Services Committee's (HASC and SASC) both expressed dismay at the actions taken by the Navy. The House committee

"notes that, although the Navy has already procured 12 T-6A aircraft in fiscal year 2000 and 24 T-6As in fiscal year 2001, it plans to discontinue JPATS acquisition between fiscal years 2002 and 2007. Expressing concern about this decision, the committee also notes that the report accompanying H.R. 2216 (H. Rept. 107-148) directed the Secretary of the Navy to provide a report to he House and Senate Appropriations committees detailing the business case for the Navy's deferring JPATS acquisition. The committee believes that JPATS procurement for the Navy would not only reduce procurement costs for both the Navy and the Air Force but would reduce operations and maintenance costs as well. The committee directs the Secretary of the Navy to report to the committee within 90 days after enactment of this Act to begin full implementation of the JPATS program beginning in fiscal year 2003."[155]

The SASC also was disappointed with the Navy's lack of commitment to the JPATS program.

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[155] House and Senate Armed Services Committee, JPATS Funding, (On-line, Internet, 3 June 2002, Available from http://www.navair.navy.mil/clo/GetDocFile.CFM/02jpats.PDF?DID=1233&Filename=02jpats.PDF), 70.

"The budget request included no funding for continued Navy procurement of the JPATS to support Navy training requirements. The Navy has been a partner in this joint program with the Air Force, although the Air Force began buying the aircraft five years before the Navy. Air Force long-term plans depended on the Navy's continued participation in the program. For the past two years, the Navy has procured these aircraft, 36 of which will be forming the initial cadre of primary trainers for the Navy. The Navy had planned to buy 24 JPATS aircraft in fiscal year 2002. The Navy has now decided that its existing trainer, the T-34C, has sufficient service life remaining to allow the Navy to delay any additional JPATS procurement until later in the Future Years Defense Program (FYDP).

The committee is concerned that the Navy is willing to take such a course of action in a joint program, where its actions obviously force the Air Force to absorb greater costs than the Air Force had planned upon. Additionally, the committee believes the improved aircrew survivability offered by the ejection seat-equipped JPATS aircraft [vs the T-34C, which has no ejection seat] is an important factor warranting continued purchases of the trainer by the Navy.

The committee recommends an increase of $44.6 million to buy 10 JPATS aircraft for the Navy. Continued purchases by the Navy would mean fielding a more efficient and safer primary aircraft training system. It would also, along with the planned Air Force buy, permit the contractor to maintain a level production effort and keep Air Force unit costs at a more reasonable level.

The committee also recognizes that the Navy's elimination of funding in fiscal year 2002 has caused the Air Force to face higher costs for the airplanes it intends to buy.

The Air Force has indicated that the loss of the 24 aircraft from the Navy buy would imply a cost increase in fiscal year 2002 of $5.8 million for the Air Force program.

Therefore, the committee also recommends a transfer of $3.4 million from the Aircraft Procurement, Navy account to the Aircraft Procurement, Air Force account to compensate the Air Force for the increased overhead that the Air Force will face as a result of the Navy's late decision to interrupt purchases in fiscal year 2002."[156]

The Senate Appropriations Committee (SAC) recommended funding $44.6 million to purchase 16 JPATS for the Navy. The Committee also noted that it expected the Navy to fund this program at economic production levels in the future. SAC also recommended an increase of $13 million to purchase T-45 operational flight trainers. After meeting in conference, the Combined Appropriations Committee (CAC) provided $30.8 million for the Navy to purchase a minimum of seven JPATS aircraft. And should production costs result in a lower than assumed unit cost, the Navy was encouraged to use whatever funds remain to purchase additional JPATS aircraft. The CAC expressed its expectation of the Navy to fund, at economic rates, additional purchases in future budget requests.[157]

Why would the Navy not fund a program that provided an improved training environment for its aviators? The answer may lie in the fact that the Navy is currently funding acquisition of six Navy-specific aircraft programs (MH-60S, MH-60R, EA-6B, E-2C, F/A-18E/F, and T-45TS), as well as joint programs such as the JPATS,

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[156] Ibid, 80.

[157] Ibid, 247.

JSF, UAV, and V-22. The bulk of Navy acquisition focus is on vessels, of which five programs exist: CVN-77 aircraft carrier, DDG-51 AEGIS destroyer, NSSN Virginia Class Submarine, LPD-17 San Antonio Class Amphibious Transport Ship, and ADC (X) Auxiliary Dry Cargo ship. The Navy may have simply made a priority decision. Since its primary mission is command of the sea, training aircraft fall to a very low position on the priority list, and the Navy apparently considered service life extension of the T-34C a viable alternative to procuring JPATS aircraft. The previous House and Senate language, however, demonstrates that the Congress is interested in maintaining the program to ensure its costs do not escalate beyond the means of both services.

Risk Assessment

The program office uses three different types of risk assessment: cost, schedule, and performance risk. The performance risk is assessed as low, although the aircraft went through significant changes during the "non-developmental" development phase. All changes will be incorporated into the production line prior to Full Rate Production.[158] Schedule risk is anticipated as being low. The major problems associated with the environmental control system (ECS) and radios pose low risk to the schedule, and these components can be retrofitted at their operating locations after production. Cost risks were assessed as medium for several reasons. The Navy budget uncertainty increased unit costs (as detailed above) to the Air Force, and the Program Office revised the buy profile to fit within constraints of the budget. A factor that may reduce costs is foreign interest. Although not included in the original Program Office estimate, any foreign sales would reduce overall unit costs. Currently, several foreign governments are

[158] SAMP, 13.

actively pursuing the T-6A as their follow-on trainer.[159] Cost risks fluctuate due to FYDP instability. The program appears to have strong Congressional support for joint acquisition and this should mitigate these risks over time.

Conclusion

The JPATS program was born under the auspices of the Navy and the Air Force jointly acquiring a common system to accomplish primary aircraft training. The effort exerted to produce a DOD Training Aircraft Masterplan indicates the services were in agreement over the benefits that could be realized using a common system. The ORD required negotiations to reach agreement, but it was signed by both services and the aircraft was selected using criteria jointly agreed upon. The aircraft was essentially remade to accommodate military training requirements, and both services began to purchase aircraft under LRIP. Suddenly, the Navy decided to pull its support for the system and fall back on the T-34C Turbomentor for its training. The Navy may have simply been making a resource priority decision by removing its funding, but Congress stepped in to make sure that one service did not suffer for the wants of another. The Navy was forced to buy more JPATS aircraft and was essentially scolded for not holding up its end of the bargain. Joint acquisition of an aircraft relies on two (or more) services who are willing to stick with a program, especially when the health of the pilot production program is at stake. The next case study, the Joint Strike Fighter (JSF), fills a requirement for several services. The JSF is also dependent on service cooperation for ensuring the success of the program.

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[159] Ibid.

Chapter 5

Joint Strike Fighter

The Joint Strike Fighter (JSF) program evolved from the Joint Advanced Strike Technology (JAST) program. In 1994, the design of a low-cost aircraft, and its associated engine and avionics technology for application to families of joint-service, multi-role aircraft and associated strike systems was the focus of JAST. Gradually, the services accepted the premise of this new program. The Air Force saw it as an opportunity to develop a follow-on aircraft for the A-10 and F-16. The missions the Air Force wanted the JAST program to cover were air interdiction, close air support (CAS), and suppression of enemy air defenses (SEAD). The Air Force also envisioned the JAST technology having secondary missions of offensive counter air (OCA), reconnaissance, and air superiority to complement the F-22. The Navy, searching for a survivable strike fighter to complement its F-18E/F Super Hornet, and the Marines, looking to replace both the AV-8B and the F/A-18C/D aircraft, also expressed interest. To replace the AV-8B, a short take-off/vertical landing (STOVL) aircraft, the JAST program had to accommodate that capability. Specifically, the missions the Marines wanted the JAST to accomplish were CAS, interdiction, and anti-air warfare. Secondary missions included SEAD,

command and control, and reconnaissance. The services agreed that the aircraft would be single-seat and single-engine to minimize costs.[160]

In January 1994, the Defense Advanced Research Projects Agency (DARPA) validated the critical technologies behind this common, affordable, lightweight fighter concept to meet the fighter/attack needs of the services with a highly common aircraft.[161] DARPA understood that the key to affordability was interservice commonality and compatibility with existing systems. Furthermore, by developing this same aircraft for export, minus sensitive technologies, the United States could retain its dominance of the global fighter attack market. For example, the Royal Navy was granted a cost-sharing relationship since they were expected to purchase 60 aircraft. Foreigners could "buy" different levels of influence; a 10 percent funding contribution "bought" influence on the requirements process. Initially, the United Kingdom was the only paying participant. The Netherlands has also shown interest in a possible replacement for their F-16s.[162]

The JAST program, billed as a fairly inexpensive approach to force modernization, incorporated common technologies to meet divergent military requirements. The combination of 70 to 90 percent commonality and integration of advanced diagnostics would cut costs over the long run. To maintain its 20-fighter-wing

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[160] *History of Air Combat Command (U),* 1996, Vol I (S) (K401.01 V. 1, in USAF Collection, AFHRA), 196. Information extracted is unclassified. Hereafter referred to as *ACC History 1996.*

[161] *ACC History 1996*, 196. Information extracted is unclassified.

[162] Ibid, 198. Information extracted is unclassified.

equivalent force structure, the United States Air Force needed an initial operating capability (IOC) date of 2010. The Air Force planned to buy 2000 aircraft to replace its F-16 fleet.[163] Air Combat Command (ACC) viewed the JAST as an all-weather, multi-role fighter, survivable in a high-threat environment, but reliant on the F-22 for air superiority. The JAST itself would have a limited air-to-air capability.[164]

Source Selection

In April of 1996, the JAST program officially became the Joint Strike Fighter (JSF) Program, and was designated a major acquisition program.[165] Its Joint Program Office (JPO) is unique because there is no executive service. Both the AF and Navy provide approximately equal shares of funding, with the United Kingdom as a collaborative partner.[166] This arrangement encourages the services to remain both truly independent and forces collaboration because no one service is dominant over the other.

An RFP to select two contractors for the Concept Demonstration Phase (CDP) required the building of two variants: STOVL and conventional take-off and landing (CTOL). All three services and the Royal Navy tasked the contractors to demonstrate

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[163] *History of Air Material Command,* 1 October 1995 - 30 September 1996, (Volume I, K226.01 V.1, in USAF Collection, AFHRA), 95. Hereafter referred to as *AFMC History 1995*.

[164] *ACC History 1996,* 199-200. Information extracted is unclassified.

[165] *AFMC History 1995*, 95.

[166] "Point Paper on Joint Strike Fighter (JSF) Mission Capabilities," CSAF Issues Book, 10 July 1997, K168.03-1823, in USAF Collection, AFHRA.

applicable capabilities for each of them.[167] After demonstrating capabilities, the CTOL version would be sent back to the factory to be converted to the Navy variant (CV). This tasking would reflect the contractor's ability to get three airframes off of one assembly line. Boeing and Lockheed Martin were selected to proceed with the CDP.[168]

Requirements

The JSF requirements process is revolutionary. The Joint Initial Requirements Document (JIRD) was designed to be a living document, subject to four annual revisions, with an approved Joint Operational Requirements Document (JORD) due in FY2000.[169]

ORDs of the past, written as responses to intelligence estimates, contained system capabilities as specified by the individual services. The JSF is unique because affordability is now a requirement. In the past, the operators, through the ORD, specified the design parameters of the system, rather than the performance parameters of the system. The JSF JORD determines what the system is designed to do, and the contractors have more freedom to find affordable solutions to the operational challenges.[170] The process followed by the JSF team was cooperative, disciplined, and iterative over a five year period. The process involved warfighters (pilots and

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[167] *AFMC History 1995*, 96.

[168] *ACC History 1996*, 200. Information extracted is unclassified.

[169] Ibid, 201. Information extracted is unclassified.

[170] "White Paper," Joint Program Office, 2002, 12.

maintainers), operations and costs analysts, designers, and manufacturing technologists.[171]

The warfighters defined operational issues in the form of questions, and developed a proposed concept of operations (CONOPS). These formed the basis for the requirements definition. Industry and the warfighters then used these operational requirements to perform cost and operational performance trades (COPT). This process enabled the design teams to determine where specific requirement capabilities were driving costs with marginal operational return. The warfighters were becoming "informed consumers" allowed to formulate a strategy that provided the highest return on investment in terms of operational capability for minimum cost, or the "Best Value" solution.[172] This knowledge formed the basis of the JIRDs. The JIRDs outlined the design space/operational capabilities in terms that the warfighters required the contractors to achieve in order to satisfy their operational needs. With each annual JIRD update, the contractors modified the design for the family of aircraft, balancing performance, cost, and risk. The warfighters then reviewed the updated configurations to understand the implications of the individual requirements on the family of aircraft in relation to cost and performance. Having achieved a better understanding of the implications of their requirements, the warfighters would then revise their CONOPS and the process would start over. Each major iteration took approximately one year to complete.[173] The process

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[171] Ibid, 12.

[172] Ibid, 13.

[173] Ibid, 13.

demonstrated that commonality, in terms of design concept and operational requirements, was the key to achieving the affordability goals of the program.[174]

JIRD I was signed in August of 1995. JIRD II was signed in September of 1997. JIRD III was scheduled for an August 1998 release, however, there were many trades occurring between the services.[175] In April of 1998, the STOVL engine was assessed to have the highest risk associated with the program. At issue were the different approaches taken by the competitors. The Boeing aircraft employed the tried-and-true method of directing exhaust gases to provide the lift required for vertical landings and take-off. Lockheed developed a slightly different technology. The Lockheed design incorporated a "cold–lift" fan driven by a shaft from the engine. The Boeing method provided adequate lift for the operational requirements of the STOVL. The Lockheed method, if successful, would provide substantial increases in lift capability, increasing the combat effectiveness of the aircraft. The STOVL aircraft designs, however, impacted the other families of aircraft because of the integrated nature of the assembly line. The cost and weight growth of the STOVL version affected the CTOL version by trading space and affordability.[176] The Air Force planned to undertake rigorous analysis to determine their path for the upcoming trading process for JIRD III. Only close coordination across the USAF could ensure the correct trades were made.[177]

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[174] Ibid, 14.

[175] *History of Air Combat Command* (U), 1999, Vol I (S) (K401.01 V. 1, in USAF Collection, AFHRA), SD-493, 1.

[176] Ibid, SD-494.

[177] Ibid, SD F-494.

Within three months, the Air Force was ready to trade. The Air Force decided to make some maneuverability adjustments, specifically to rewrite the corner airspeed requirement to read "comparable to 4th generation fighters."[178] The Air Force also deleted the specific excess power requirement, but added the internal advanced gun, although the specific type of gun and the cost impact had not yet been determined.[179] The USMC made concessions in an attempt to allow the contractors to meet the STOVL performance levels. The Marines increased the short take-off (STO) distance by 50 feet and lightened the fuel load for STO. The Marines also reduced their Vmax from 750 KCAS to 700 KCAS, and reduced the design g from 8.0g to 7.0g. They also changed the corner airspeed requirements, but left the design problem itself unchanged.[180]

The process worked for many issues that came up between the services. However, there were contentious issues that affected all of the design variants, and the services fought to save their versions. In June 1998, Major General Kenne, the JSF program director, decided to force a 7.5g limit and internal carriage wording for all JSF variants "to help solve the STOVL weight/cost problem."[181] The Air Force and Navy contingents went to work. The Air Force Systems Management Office (SMO)-JSF recommended 8g as required for survivability based on analysis, and no cost or weight savings would be realized by changing the requirement to 7.5g.[182] ACC/DR (Director of

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[178] Ibid, SD F-495, 2.

[179] Ibid, SD F-495, 2

[180] Ibid.

[181] Ibid.

[182] Ibid.

Requirements) recommended that the AF non-concur with Draft JIRD III based on a set design g-limit. ACC/DR's initial assessment stated that the Marines had not made enough concessions to fix all of the STOVL problems. Consequently, ACC/DR suggested that range and corner airspeed were good candidates to help the STOVL problem. The USMC, apparently experiencing internal troubles, attempted to forge a consensus between its own internal fighter communities (Hornet vs Harrier) over STOVL priorities. The process worked, however, because the issue was resolved and the JIRD III was accelerated and briefed to the JROC in September 1998.

Operational Capabilities

The services defined what they required to meet the warfighting challenges of the future in the ORD. The ORD was the result of five years of requirements, cost, and operational design trade studies. The following list identifies each service's top level JSF requirement:

USN – Stealthy multi-role fighter to complement the F/A-18 E/F

USAF – Stealthy multi-role fighter (primary air-to-ground) fighter to replace the F-16/A-10 and to complement the F-22

USMC – Stealthy multi-role, short take-off, vertical landing strike fighter to replace the AV-8B and F/A-18A/C/D.

UK Royal Navy and Royal Air Force – Future carrier borne aircraft (FCBA) that will be a STOVL, stealthy multi-role follow-on for the Sea Harrier FA2, the RAF GR-7, and the TMk-10 Harrier.[183]

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[183] "JSF White paper," 14-15.

Eight key performance parameters (KPP) define the capabilities and requirements of the JSF. KPP define a capability or characteristic so significant that failure to meet the threshold can be cause for concept or system selection reevaluation, program reassessment, or even program termination. The KPPs for the JSF are:

Radar Signature (All variants)

Combat Radius (All variants)

Logistics Footprint (All variants)

Mission Reliability (All variants)

Sortie-Generation Rate (All variants)

Interoperability (All variants)

Vertical Bring Back (STOVL variant only)

VPA-Carrier Approach Speed (CV variant only)[184]

The JSF KPPs focus on meeting the warfighting needs of the future. It is important to note that six of the eight KPPs are joint, and only two are service-specific. Three of the eight are supportability related and have a significant impact on reducing the cost of ownership.[185]

Status of the Program

In a press release from the DOD on 26 October 2001, Under Secretary for Defense Acquisition, Technology, and Logistics Edward C. "Pete" Aldridge, Jr., then

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[184] Ibid, 15.

[185] Ibid, 15.

Secretary of the Air Force who cancelled the T-46A, announced that the JSF program would proceed with the next phase. The System Development and Demonstration phase (formerly known as Engineering and Manufacturing Development (EMD)) focuses on developing the family of strike aircraft to meet the operational requirements of the services. The Secretary of the Air Force, James G. Roche, announced the selection of Lockheed Martin, teamed with Northrop Grumman and British Aerospace (BAE), to develop and then produce the JSF. The contract, for $19 billion (FY01), will produce aircraft for the Air Force, Navy, Marine Corps, and UK's Royal Air Force and Navy.[186]

The JSF acquisition strategy also calls for the development of competing propulsion systems. Both Pratt & Whitney and the team of General Electric and Rolls Royce are expected to receive contracts for the next phase of development. Both propulsion systems will be physically and functionally interchangeable in both the aircraft and support systems and all JSF variants will be able to use either engine.[187]

Program Assessment

The JSF program is managed by a Joint Program Office, staffed by personnel from all of the interested services. As the largest consumer, the Air Force mans most of the staff positions. However, all the services recognize the importance of this aircraft to the future viability of their aircraft fleets and provide the appropriate level

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[186] Department of Defense Press release, "JSF Contractor Award," 26 October 2001, n.p. on-line, Internet, available from http://www.defenselink.mil/news/oct2001/b10262001_bt543-01.html.

[187] Ibid.

of support. The past lessons of the TFX program weigh heavy on the JSF program; the services are committed to ensuring program success. The following paragraphs will evaluate the JSF program with respect to anticipated cost, schedule, and performance.[188]

Cost

Unlike the TFX, the JSF flyaway unit cost has been the focus of attention throughout the program. In fact, the concept of cost as an independent variable (CAIV) is the cornerstone of the JSF program. CAIV treats cost as an input rather than as an output or a result. CAIV promotes cost and performance trades early in the life of the program. CAIV also supports the development of an "educated" consumer by providing timely insight into the cost and operational benefit of system requirements. Specifically for the JSF, the unit flyaway cost and lifecycle costs are of primary concern.

Although unit flyaway cost is not the bottom line, it is the best that can be tracked. Life cycle costs are too difficult to track, given the different accounting systems for the separate services. However, the program did not ignore the problems associated with life cycle costs; the JSF program office made the sortie generation rate, logistics footprint, and mission reliability key factors for the contractor to attain. The contractors and the

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[188] The following information is derived from interviews (telephone and e-mail) from Paul W. Wiedenhaefer of the Joint Program Office. Mr. Wiedenhaefer has been involved in acquisition of systems for many years, and has experience with the following programs: F-14D, NATF (Navy A-12 program), AFX/AX (Navy A-6 replacement, eventually became the JAST program), F-22, F-117, C-130 and "a bunch of other weapon programs." His experience is vast and his comments constitute much of the information provided.

services are working together to make the avionics systems 100 percent common. The unit costs do not include the costs associated with a ground-based training system or simulators. As of June 2002, the JSF program is within 5 percent of the target cost. Even with the selection of Lockheed Martin (LM) as the contractor, the program continues to provide incentives that reward the company for meeting or beating the budget.

Schedule

The JSF schedule has many factors to consider. Internally, the two main factors affecting the schedule are developmental/operational testing and the time it will take to write the estimated 16 million lines of code for the avionics suite. The schedule currently reflects the eight years required to write the code and test it within the system and aircraft, both on the ground and in the air. These two programs will run concurrently as technicians work the bugs out of the system. The program office reports that there are external issues as well. Externally, certain agencies have asked the program to shorten its development schedule.[189] To shorten the schedule would force the services to give up capabilities and/or significantly increase the risk associated with the program. Many outside the program expect technology to shorten the development time of major weapon systems. What these agencies do not realize is that the program is designed to produce approximately 3-4 times the capability of the legacy systems replaced.

Performance

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[189] These agencies remain nameless due to sensitive issues related to the program office.

The performance capabilities of the JSF are unique in that they were derived from all the services. The design focus for the aircraft is its capability as a strike aircraft. Using this as a point of departure, the JORD then developed the requirements for the separate services, specifically the Navy's carrier operations capability and the STOVL capability for the USMC. Carrier operations have not affected the performance of the aircraft as in the case of the TFX. Since the JSF is a "family" of aircraft, the services benefit from approximately 70 percent commonality. When it made sense to have a common part, it was kept common; conversely when a part needed to be unique, it was made so. Manufacturing technology allows the production of what are termed "cousin" parts -- almost common. These "cousin" parts have the same form and function, but they may be made of a different material or have a different thickness. Advances in computer-aided manufacturing since the 1960s significantly help in the production of the "family" of aircraft and "cousin" parts.

Somewhat reminiscent of TFX, the most difficult design challenge was the STOVL requirement pushed by the USMC. The STOVL version is extremely weight-critical and, as such, drove the other services to work their requirements around the USMC version.

Conclusion

In the world of joint acquisition, the JSF program is unique. The program is unique because it combines the strike requirement of four separate services and blends them into a family of aircraft that should achieve approximately 70 percent commonality. The services have had to work together, trading requirements and capabilities to maintain

a steady unit cost. By utilizing the CAIV methodology, the risks associated with requirements "creep" and cost escalation that eventually led to the downfall of the TFX program have been mitigated. Perhaps the most daunting task is to maintain the level of service commitment required to see the program to its fruition. The JPATS program indicates that if the Navy gets into a bind on the budget, it is willing to make program choices and focus on the core of its missions, the fleet. Although the JPATS is a training aircraft, and the JSF is a combat aircraft that is to fill a valid requirement, the Navy still might select a competing alternative. The JSF is supposed to replace the aging F-18A/B/C/D fleet. If the Navy gets into a budgetary crisis, will it decide to extend the service life of the F-18 fleet? Is that a viable alternative? These are the types of risk that are associated with the JSF program as it stands today. The program enjoys support from all the services, as well as our allies in Europe.

Including our European allies in the buy of aircraft has two advantages. The first, and most obvious advantage, is the reduction of unit cost of the family of aircraft from a longer production run. The second advantage is that the program now has support from militaries outside of DOD. This is an advantage because it does not allow our Congress to unilaterally remove funding from a program without having to deal with these other nations. The T-46A program was easy to kill; the JSF program would not be so easy.

Chapter 6

Conclusion

The genesis of this study was the perceived inability of the services to work together towards a common goal of producing an aircraft. Can joint acquisition and joint procurement of aircraft be achieved without endangering performance requirements specialized for separate services? Five case studies were examined in an effort to answer the question. Cost, schedule, and performance for each of the programs provided the analytical framework.

The case studies indicated that the services' need for the aircraft at the time of program inception was insufficient to guarantee joint completion. As the programs became more costly, the services began to search for viable alternatives. In the case of the TFX, the Air Force took the resulting design and turned it into a combat-proven aircraft. The Navy jumped ship and turned the F-4 into their fleet defense aircraft, while waiting to eventually acquire a true fleet defense aircraft, the F-14. The T-46A program, cancelled due to contractor malfeasance, left the Air Force without an alternative, so it created one. The T-37 Structural Life Extension Program (SLEP) became the Air Force's alternative. The SLEP provided the time needed to decide on how to best replace the primary training aircraft of the USAF. The T-45 program indicated the Navy's need for an advanced trainer, even if it cost more than expected. The conversion of a land-based aircraft to carrier operations required more work and adjustments than both the Navy and the contractor had expected. However, the Navy's preference for remaining with the

program in spite of its developmental problems suggests the Navy did not have a viable alternative.

The JPATS program was the first instance in which the Air Force and Navy collaborated on acquiring a primary training aircraft. The services came together and worked out their differences for designing a primary trainer. The levels of cooperation should have indicated that both services needed and wanted the aircraft. Nevertheless, appearances are deceiving as the Air Force has funded the system completely, while the Navy recently attempted to remove its funding. The Navy considered extending the T-34C service life a viable alternative; but the Congress of the United States has a different plan. Congress instructed the Navy to continue funding because it had committed itself to the program, and any reduction in commitment would result in a cost increase to the Air Force.

Finally, the JSF demonstrates that the acquisition community has learned a few things over the years. The cost growth associated with developmental aircraft systems has been kept in check by using cost as an independent variable (CAIV). This way, the services and the contractors must consider the inevitable changes to the requirements and keep the aircraft under a certain flyaway cost ceiling. In this light, the operators know that any increase in capability in one arena will more than likely translate to a reduction in capability in another. This cost-benefit analysis is what has kept the program funded and supported by our military as well as allied nations. The future of the JSF program is based on the continued support of the services and nations in the program. If an alternative that is better, or cheaper, becomes apparent, will any of the services bail out and accept this alternative?

So, can joint acquisition and joint procurement of aircraft be achieved without endangering performance requirements specialized for separate services? The history would suggest that for joint acquistion to be successful, there are two conditions required: need and a common mission. The services must have a need that is so compelling, a need that does not provide any alternatives, a need that is so overarching that if not met it would seriously detract from mission accomplishment. Yet alternatives tend to emerge: the F-4, T-37 and T-34C SLEPs come to mind. Therefore, there must be another way to enforce an acquisition decision once made. Congress has provided evidence that it is willing to step in and enforce joint decisions, as shown in the JPATS program. Once a service makes a commitment to a program it must be held accountable for those decisions. To allow one service to bail out without penalty is an injustice to the other services involved. Commitments for joint programs must be both sensible and serious. This study suggests the commitment must be enforced by an outside agency – either DOD or Congress, lest other priorities intervene. The other key ingredient for a successful joint program is a common mission.

The JSF and JPATS provide strong evidence that a successful program will result when an aircraft is jointly acquired for a common mission. The JPATS fills the primary training requirements for the Air Force and the Navy, provides a common frame of reference for Naval and Air Force pilots, and provides substantial savings to the government in unit and life cycle costs. The JSF, while still in relative infancy, has shown great promise for many of the same reasons. The history of joint acquisition suggests that stern guidance from the agencies that control service funding will be required to fulfill that promise.

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